ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

SEPTEMBER 1959

PRICE ONE DOLLAR

FOUNDED 1866

MINE OPERATORS' ROUNDUP

PLANNING GROUND CONTROL — Cananea Copper and Colorado School of Mines tell how drill core data help out. p 88

TRANSPORTING SOLIDS VIA PIPELINE — Early experiments were fascinating; future applications may be startling. p 93

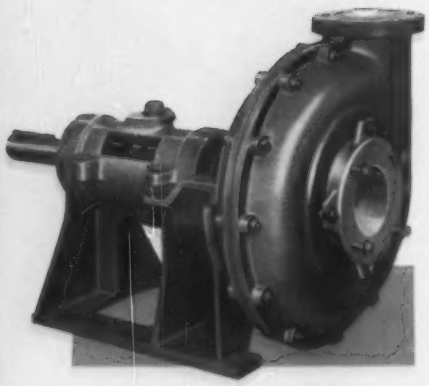
SOLVING ORE PROCESSING PROBLEMS — A-C's pellet pilot plant tackles agglomeration and heat-treating of many raw materials. p 98

MILLING IN SOUTHEAST MISSOURI — A look at major improvements in Lead Belt mills and what the next 10 years will show. p 102

DESIGNING AN EARTHQUAKE-PROOF SMELTER STACK — How Chuqui studied Andean geology and came up with the answer. p 116

GETTING UP IN DRIFTS — A Swedish monorail platform elevator adds safety and speed to vertical and inclined raising. p 122

THE ORIGINAL PARTS IN HYDROSEAL PUMPS STILL WORKING AFTER 330 DAYS



Excepting the interchangeable impeller and engine-side shell half-liners, these Hydroseals are identical with Centriseal pumps, which deliver the pulp undiluted.

These Hydroseals are C-6-5 Frame split-shell, rubber-lined pumps. They are running on secondary ball-mill discharge at a gold mine near Johannesburg, Union of South Africa. After 330 working days, not one single part has been replaced since the pumps were delivered by our licensed manufacturer, The Denver Machinery Co., (Pty.) Ltd. For details about these superior pumps, write us for our Brochure No. 457.

DUTY DATA

Imp. GPM . . 750
TDH. . . . .65 feet
Sp.Gr. 1.37

Screening

+ 48 . . . 16.4%
+100 . . . 34.8%
+200 . . . 21.2%
−200 . . . 27.6%

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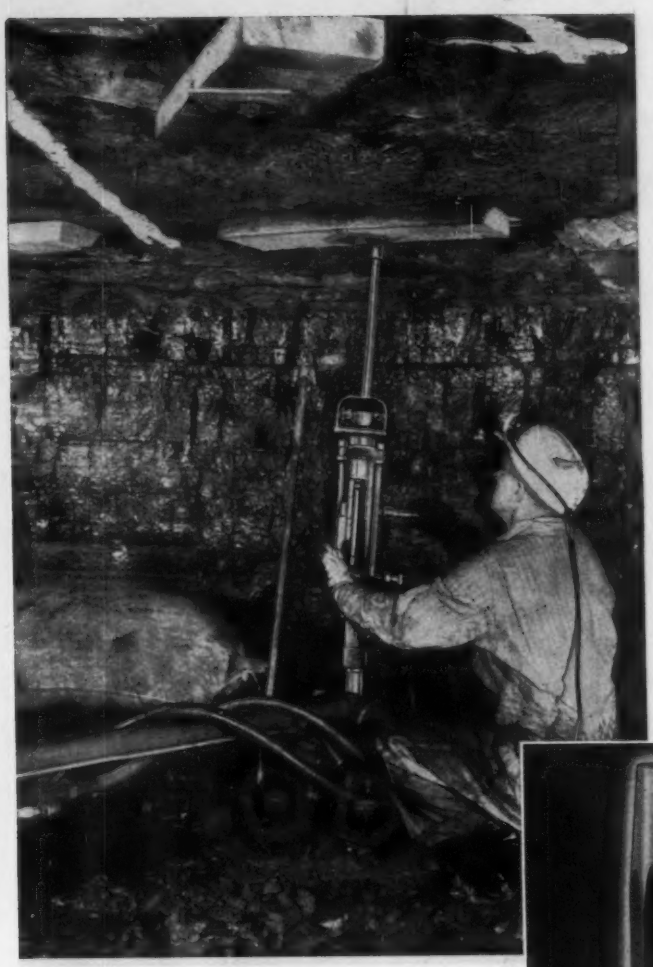
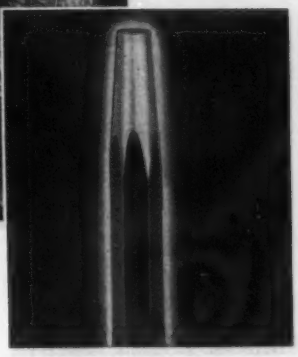
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED



VACUJET

Drilling Team cuts roof bolting costs 3 WAYS!



1. VACUJET DUSTLESS STOPER CUTS OPERATING COSTS

Here's a stoper that includes its own built-in dust-removal system—gives you fast, clean drilling without any additional vacuum equipment. An ejector jet built into the drill backhead creates a vacuum that pulls all dust and cuttings down through the hollow drill steel and ejects them under positive pressure to any convenient dust collector. Even a simple canvas bag, as shown above, serves the purpose.

Because of its highly efficient ejection system, the Vacujet Stoper uses 15% less air and provides greater drilling power and speed. It's easier to set up and use, too. There are only two hose connections to the drill—the compressed air line and the dust discharge hose.

If you haven't tried the Vacujet, you don't know how simple and economical dry dustless drilling can be. Ask your I-R engineer for complete information, or send for Bulletin 4195.

2. CARBURIZED DRILL STEEL CUTS ROD COSTS

Ingersoll-Rand *carburized* drill steel is specially treated to provide exactly the right combination of hardness and core toughness to withstand millions of impacts without molecular fatigue. On job after job, these super-steels have outlasted ordinary alloy steel rods by two-to-one! This means less steel to handle—less time out for rod replacement. Rods are easy to recondition, too—simply cut off shank or grind Class B taper for bit end.

3. NEW "one-use" CARSET BITS CUT BIT COSTS

Here's a long-life, heavy-duty tungsten carbide insert bit that can be drilled to destruction *without any resharpening*. One Carset bit will outlast 16 to 20 "one-use" steel bits—at a saving of up to $1.60 per bit cost alone. More important, the time saved changing steel bits is converted into drilling time. On typical applications, "one-use" Carset bits are drilling 235 ft. where steel bits lasted 12½ ft.—and 350 ft. where steel bits were completely used up in 17 feet of drilling. Available in 1½" and 1⅜" sizes, with Class B taper connection. No shims needed.

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A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

ENGINEERING AND MINING JOURNAL

93rd YEAR OF PUBLICATION

SEPTEMBER 1959

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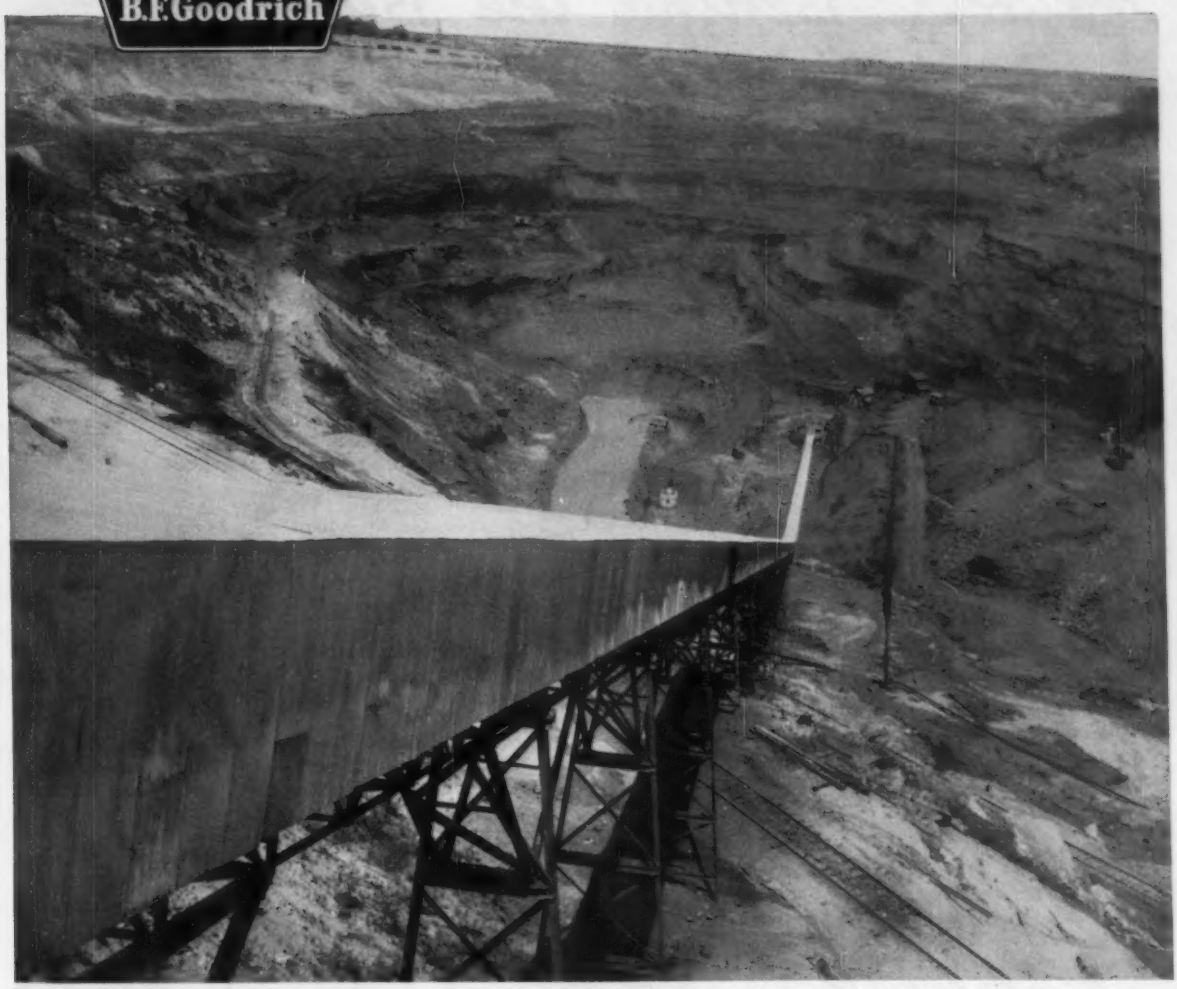
B.F.Goodrich



Nine million tons came up here

B. F. Goodrich improvements in rubber brought extra savings

OUT of that man-made hole (so deep a 30-story skyscraper wouldn't reach the top) enough iron ore has come up in the last ten years to make the steel for 2½ million automobiles. A cubic foot of the stuff weighs 125 pounds; it comes up the steep hill, ⅓ of a mile long, at the rate of 18 tons a minute.

A hole this deep once would have needed at least three belts dumping from one to the other. No belt was strong enough to pull all the weight the whole distance.

Then B.F.Goodrich developed a steel-wire-and-rubber belt, with twisted wire strands running lengthwise, each strand completely surrounded by rubber. There is half a mile of wire in every foot. Now one long belt does the whole job, has carried over 9 million tons, is still in use. It has lasted longer than any conveyor belt ever made with steel cords or cables.

This stronger conveyor belt is typical of what happens when B.F.Goodrich engineers set out to improve a product so that it will last longer, stand more abuse. That's why it pays to call a B.F.Goodrich distributor before you buy rubber products, let him tell you what new developments B.F.Goodrich has made in them.

At this iron mine money was saved by eliminating "transfer points", which would have been necessary in any system built in several stages with ordinary belts. Fewer transfer points meant less expensive equipment in the first place, and maintenance cost was reduced every year. *B.F.Goodrich Industrial Products Co., Dept.* M-680, *Akron 18, Ohio.*

B.F.Goodrich ***industrial rubber products***

Behind the By-Lines...

The feature articles this month are pretty heavy in the area of mine operation and design. They range from improved techniques in raising through a comprehensive look at transportation of solids through a pipeline, to the before-and-after story of milling at St. Joe and some practical applications of advanced research in ground control.

ERICK MIN
THE NEXT GUY THAT DON'T REPORT TO FIRST-AID POST FOR A MINOR ACCIDENT WILL REPORT THERE FOR A MAJOR ONE!!
J. James Supt.

"I'm getting tired of the soft sell!"

The latter story, by Dr. Arthur W. Ruff and Prof. Lute J. Parkinson (see below), concerns the practical application of theory and analysis to mining methods.

Drill cores, when properly studied, provided data for future driving of drifts at Cananea, and the rock support problems which might be expected. And, the authors say, the Ruff-Parkinson method shows promise in the development of haulageways, planning new areas for block caving, and (in cooperation with soil mechanics analysis) predicting maximum safe pit slopes. Dr. Ruff, a scholar with a hard hat, proves that theoretical study can pay off in the field.

"Each mill," says H. A. Hoffman in his article on milling progress at St. Joe's four plants in Missouri, "may be regarded as a separate problem . . ."

The story, beginning on p 102, outlines the full history and current progress at the properties, with chapter and verse to help you apply the information to your problems. But then Mr. Hoffman serves up dessert.

In the section headed "Looking to the Future," he notes a few thoughts on the possible future of gravity concentration, pneumatic machines, cyclones, automatic controls, rapid analysis and improved communication.

There's more for the operator of today's mine as you go deeper into this issue: On p 98, the description of a new pilot plant service; on p 110, an excellent ore reserve estimating method; on p 116, techniques for designing stacks in earthquake country, with a layout of Chuqui's plant; on p 120, a simple aid to raise surveying. All right operators, operate!

Our friends at Freeport Sulphur Co. probably knew they were toying with fate when they supplied a jeep and a pickup truck to service the mine at Garden Island Bay. Vehicular traffic can only reach the property on one of two plank roads which stretch six miles over the salt marshes. It was just a matter of time. Everybody can relax now, though. There was a collision a while back: two vehicles, two roads, one intersection.

While a poet may garner his inspiration from any source, we're particularly pleased that Carl O. Bay, secretary of Ontonagon Mineral Land Association, Ltd. found his in the pages of E&MJ. Not only does Mr. Bay credit our editorial for the basis of his poem, but also supplies footnotes—an unusual and laudable poetic practice—for his references.

The poem, which was pasted inside an interesting book called "This Ontonagon Country," by the late James K. Jamison, follows:

> Copper, Copper, everywhere
> But how're you gonna fetch it?
> With natural gas and fission fuel*
> You might melt the rock and 'ketch it.'
> With aeroplanes and 'birdies' too,
> You'll spot a place most likely,
> Yet the direction, sir, I'm told
> Is down** sir, that's most 'strike-ly.'
>
> * E&MJ, April 1959, page 19
> ** E&MJ, May 1959, page 85

There's a new game going around the shop, based on the creation of new versions of the old flowery collective nouns of Victorian times. In those days, of course, it was "a pride of lions," or a "brace of ducks," or maybe a "gaggle of geese."

The later-day variations have included "a gangle of schoolboys" and "a giggle of schoolgirls," etc. One of our own proudest contributions was the offhand mention that, every month, we receive news items from a "sheaf of correspondents." Our cellmate to the east suggested "a raft of Polynesians," and escaped with only minor contusions.

Before leaving, however, he contributed the following samples for possible use in the industry:

"A battery of cells; a couple of pipes; a bank of deposits; a brace of timbers.

Our spouse has suggested that the War of the Roses was a clash of symbols. Disqualified.

There's a profit to be found, often in the most unlikely places. Take our good friend Prof. Lute J. Parkinson, head of the mining department at the mineral engineering college, Colorado School of Mines.

Just because early patent regulations insisted on the submission of a scale working model along with the patent requests, and because Maxwell L. McCormack of Ingersoll-Rand wanted to make a gift to his alma mater, Prof. Parkinson's department is now in possession of a 100-year old model of the Fowle drill. The Fowle was the first mechanical drill used in the U.S., and contained several advanced engineering features. The drill operated with self rotation and automatic feed, used a detachable bit and steam power. Mr. McCormack (right above) made the presentation earlier this year.

CATERPILLAR'S **No. 1** PROJECT

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SynchroTouch

HOW IT WORKS

SynchroTouch Transmission Control uses hydraulics as a source of power and is activated and controlled electrically. When the desired gear is dialed, the following sequence occurs on an upshift in a split second:

1. Control Unit signals master clutch to disengage.
2. Control Unit signals hydraulic system to shift transmission to neutral. Shifting collar is disengaged from present gear.
3. Generators notify Control Unit when transmission is synchronized for shift (shifting collar and desired gear at same RPM).
4. Control Unit signals hydraulic unit to shift to desired gear. Shifting collar engages new gear.
5. Control Unit signals master clutch to re-engage. SHIFT COMPLETE.

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FOR TOUCH AND GO SHIFTING

Now Caterpillar research gives you an advanced new way to shift gears. Operator simply dials desired gear. Split-second shifting. Available for DW20 and DW21.

From Caterpillar's No. 1 Project* comes one of the most important earthmoving developments of recent years—*SynchroTouch Transmission Control.* This remarkable advance combines economical direct drive transmission with the easiest, fastest shifting imaginable.

SynchroTouch Transmission Control is an optional arrangement for Cat DW20 and DW21 Tractors that permits effortless shifting of transmission gears by means of a gear selector conveniently placed near the operator's right hand.

To shift up or down, the operator simply moves a selector switch to the desired gear. In less than a second it is engaged. The standard foot clutch is retained, but it is used only when starting from a standstill.

Fully job tested in the field, SynchroTouch Transmission Control is ready now to give you these benefits:

1. Faster shifting—for faster cycles, more payloads per hour. 2. A significant reduction in operator fatigue—for higher daily production. 3. Economical direct drive transmission—uses standard DW20 and DW21 transmission and clutch components. 4. No special maintenance required.

Add SynchroTouch Transmission Control to either the new DW20 or DW21 Series G, and you have the last word in modern, high-speed, efficient earthmoving.

Both of these outstanding Caterpillar wheel-type Tractors are delivering more horsepower (345 HP), more rimpull and greater capacity than ever before. Now see them in action with the SynchroTouch Transmission Control!

Call your Caterpillar Dealer today—and ask for a profit proving demonstration.

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*Caterpillar's multimillion-dollar research and development program—to meet the challenge of the greatest construction era in history with the most productive earthmoving machines ever developed.

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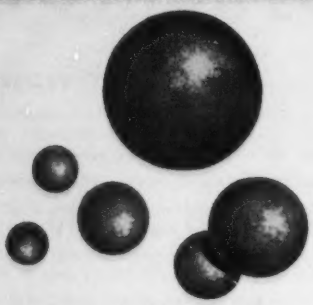
The Image of CF&I—a giant steelman—reflects the years of experience gained in developing and improving hundreds of CF&I steel products for many industries.

Typical of the wide range and top quality of all our products is CF&I's line of steel products for the mining industry. CF&I has been serving the needs of the mining industry since 1882. CF&I Mining Products are fabricated from quality steels produced in our own mills . . . and every product is tested, controlled and inspected during all steps of manufacture so that the industry's highest standards are met or exceeded. Performance has been thoroughly field-tested in our own mining operations as well as in those of our many customers.



CF&I grinding balls

Available in diameters from ¾″ to 5″. Made from high-carbon steel with the ideal hardness-toughness balance to assure optimum grinding ability and wearability under the most severe conditions involving abrasion and impact.

CF&I rock bolts and Realock metallic fabric

CF&I expansion shell type rock bolts with Pattin expansion shells are available in ⅝″, ¾″ and ⅞″ bolt sizes, in lengths from 24″ to 96″. Complete line of 1″ slot and wedge type bolts also available. Used in conjunction with Realock metallic fabric, CF&I Rock Bolts reduce need for timbering and provide safe, economical, permanent support.

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mining industry

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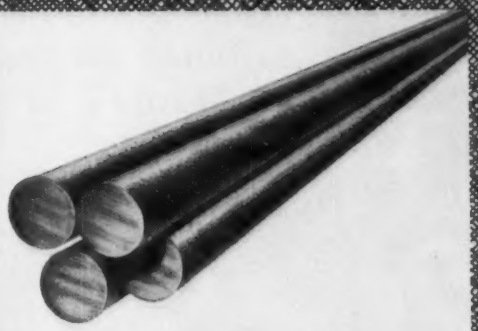
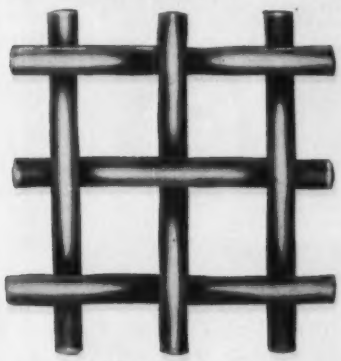


CF&I grinding rods

Available from 1½" to 4" diameters in sizes of ½" increments. Hot-rolled, machine-straightened, square-cut ends, made from special analysis steel to insure hardness for resistance to abrasion and bending; toughness to eliminate any premature breaking.



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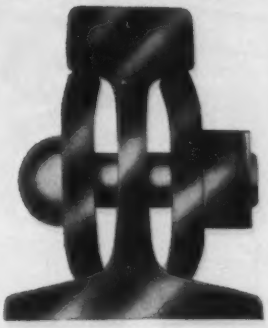
Available in a wide variety of meshes, metals and weaves to satisfy every screening need. Made from the toughest steels and alloys for processing, cleaning, grading, filtering or screening applications, where resistance to corrosion, vibration, abrasion, fatigue or heat is needed.



CF&I mine rail and fastenings

Available in the range from 12 to 45 pounds. CF&I Mine Rail meets all A.R.A. specifications. Fastenings include: splice bars, angle bars, spikes, track bolts and nuts (both square and hexagonal).

CF&I-Wickwire wire rope

Available in all sizes, types, constructions and grades—including Double Gray *extra*-improved plow steel for applications where *extra* high strength is needed. CF&I-Wickwire Double Gray Wire Rope, made with an independent wire rope core, has a 15% higher breaking strength than the catalog breaking strength of improved plow steel wire rope with independent wire rope core.

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4806

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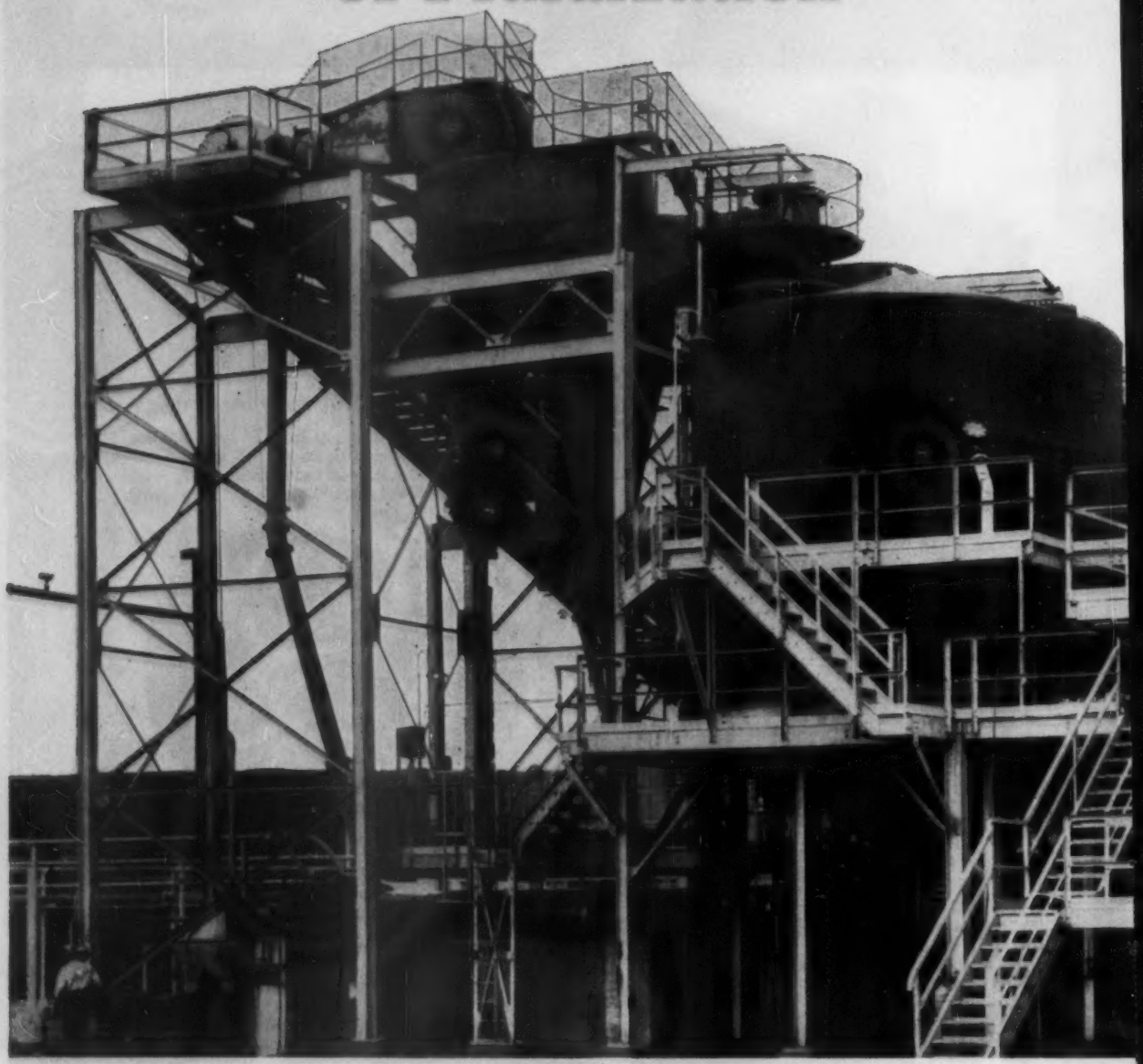
CF&I OFFICE IN CANADA: Montreal

CF&I STEEL

More proof of versatility of Fluidization



What is Fluidization?

A valuable new tool for the mining and process industries. When particles are suspended in an upwardly moving stream of gas, the entire dense mass behaves much like a liquid and is said to be fluidized. Applied in the Dorrco fluid bed reactor, fluidization results in a new and more efficient roasting technique, in which each particle of material is individually surrounded by a film of air or gas supplied by an external blower. A combination of reactor, cyclones and other auxiliary equipment forms a complete processing system, adaptable to a wide range of applications.

HELP FOR YOUR PROBLEM: If there's a step in your process where intimate contact between solids and gases is required, fluidization should be investigated. Dorr-Oliver will be glad to work with your research and development men, run pilot plant tests at our laboratories, or cooperate in any other way to insure a realistic evaluation in terms of your particular needs.

Dorrco FluoSolids system produces cobalt, SO_2, and Fe calcine in a single roasting operation!

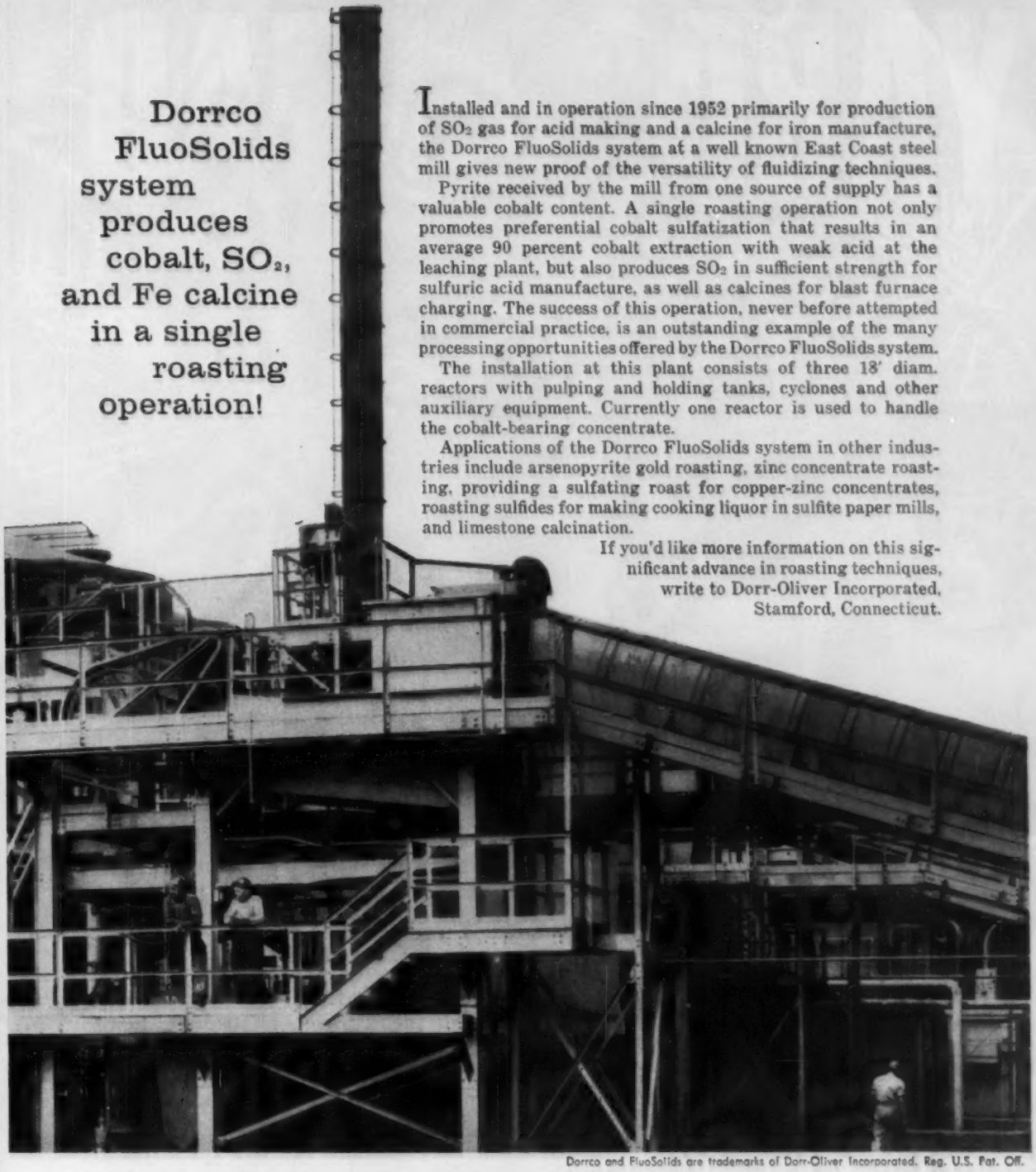
Installed and in operation since 1952 primarily for production of SO_2 gas for acid making and a calcine for iron manufacture, the Dorrco FluoSolids system at a well known East Coast steel mill gives new proof of the versatility of fluidizing techniques.

Pyrite received by the mill from one source of supply has a valuable cobalt content. A single roasting operation not only promotes preferential cobalt sulfatization that results in an average 90 percent cobalt extraction with weak acid at the leaching plant, but also produces SO_2 in sufficient strength for sulfuric acid manufacture, as well as calcines for blast furnace charging. The success of this operation, never before attempted in commercial practice, is an outstanding example of the many processing opportunities offered by the Dorrco FluoSolids system.

The installation at this plant consists of three 18' diam. reactors with pulping and holding tanks, cyclones and other auxiliary equipment. Currently one reactor is used to handle the cobalt-bearing concentrate.

Applications of the Dorrco FluoSolids system in other industries include arsenopyrite gold roasting, zinc concentrate roasting, providing a sulfating roast for copper-zinc concentrates, roasting sulfides for making cooking liquor in sulfite paper mills, and limestone calcination.

If you'd like more information on this significant advance in roasting techniques, write to Dorr-Oliver Incorporated, Stamford, Connecticut.



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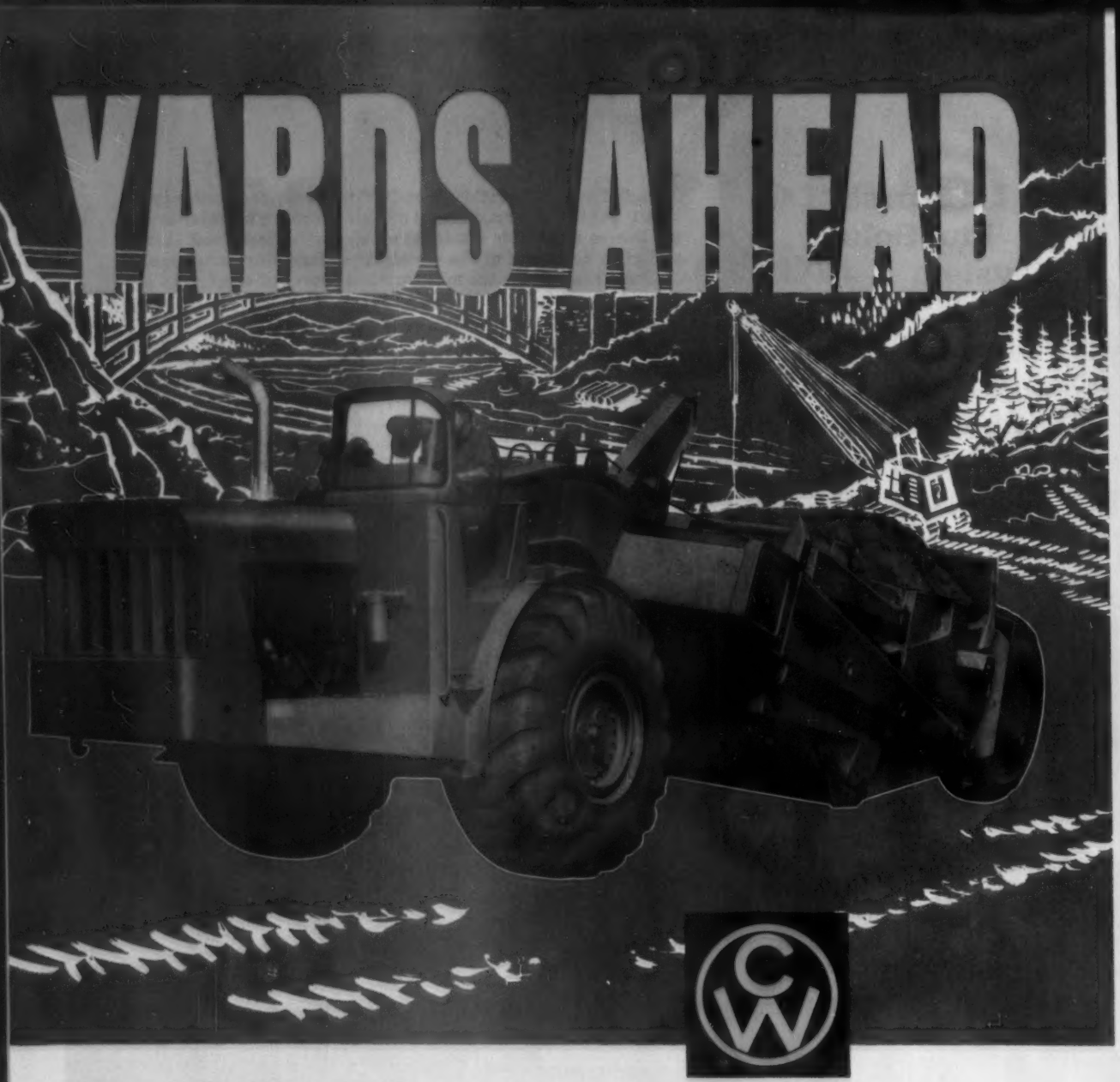

CURTISS-WRIGHT MODEL

226

CW-226 SELF-PROPELLED SCRAPER

Capacities: 26 cu. yds. struck, 36 cu. yds. heaped, 78,000 pound rated load

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CURTISS-WRIGHT DISTRIBUTOR

Throughout the cycle — from the easy loading, through the high speed travel, to the fast dump, you're YARDS AHEAD with Curtiss-Wright scrapers. Designed and built to meet the skyrocketing production demands of today's construction industry, the CW-226 gives users a daily output unmatched by any competitive machine. See how the CW-226 can give your job a production boost — Let your C-W distributor give you complete details on the "Yards Ahead" features of the Curtiss-Wright line.

SOUTH BEND DIV. CURTISS-WRIGHT CORPORATION, SOUTH BEND, INDIANA

SOUTH BEND DIVISION

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CORPORATION

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Goodyear builds a giant to do a giant's job! In this 10-foot, two-ton tire is enough rubber for 320 car tires, enough nylon for 7,200 pairs of stockings. It's the largest tire ever made.

Tire for the Future to Roll on—

The earth-mover for which this tire was designed may still be on the drawing board.

Why, then, has Goodyear invested a quarter-million dollars in equipment to produce this giant off-highway tire?

Simply because, in this age of prodigies, earth-movers of enormous size soon will be taking awesome bites of earth to change the face of ever-building America.

The loads will be staggering, the footing generally bad, the traction uncertain. So Goodyear tire research and engineering men are solving these problems even before builders come to grips with them.

With Goodyear tires like this one, weight distribution will be such that 50-ton loads will bear approximately no more heavily on the earth than would your car.

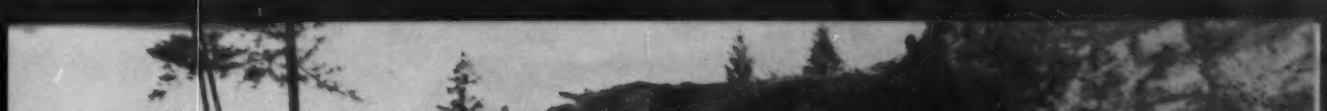
Fantastic loads will not dig themselves in. Steady traction will move them efficiently regardless of soil conditions. And super-tough treads will fight gouging, chipping and abrasion to keep equipment steadily in service.

You might call this titanic tire a prototype—a research specimen—a proof of unique tire-building ability.

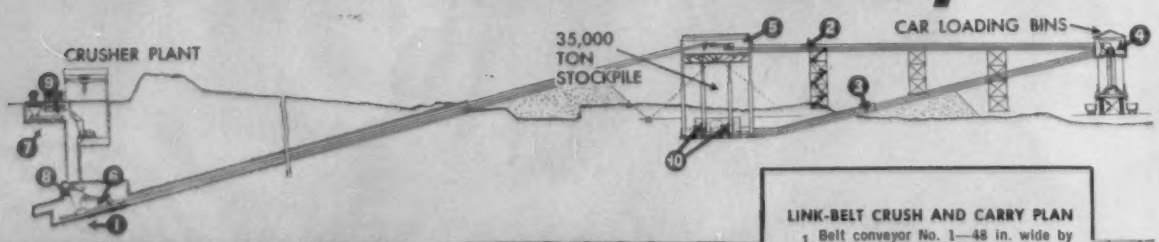
But better call it just the Goodyear way of being ready—well ahead of time—for the future. And the future begins at the next tick of the clock.

GOODYEAR

MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND



Flexible flow at Berkeley Pit



LINK-BELT CRUSH AND CARRY PLAN

1. Belt conveyor No. 1—48 in. wide by 1018-ft. centers, inclined from primary crusher to drive house.
2. Belt conveyor No. 2—48 in. wide by 504-ft. centers, horizontal from drive house to transfer house.
3. Belt conveyor No. 3—48 in. wide by 558-ft. centers, inclined from beneath stockpile to transfer house.
4. Belt conveyor No. 4 (pictured at left) with traveling tripper, extends over ore bin and discharges to car loading bins.
5. Belt conveyor No. 5—60 in. wide by 20-ft. centers shuttle belt which receives from belt conveyor No. 1 and feeds to belt conveyor No. 2.
6. Picking belt conveyor—72 in. wide by 30-ft. centers.
7. Troughed conveyor—60 in. wide by 45-ft. centers, carries dribble from wobbler and apron feeder to storage.
8. Heavy-duty manganese steel apron feeder under 400 ton ore pass.
9. Heavy-duty manganese steel apron feeder under truck hopper.
10. Four heavy-duty manganese steel apron feeders under stockpile.

Heavy duty LINK-BELT belt conveyor system handles 1800 tons of copper ore per hour

This mammoth Montana pit is Anaconda Copper's newest project in its long-range open pit program. In designing and erecting the *entire ore handling system*, Link-Belt engineers made provision for wide flexibility of belt conveyor flow patterns. Four separate routes are possible for transporting the ore from crusher plant to stockpile and car loading bins—all geared to high tonnage capacity . . . all adding to economical mine operation.

This unique flexibility is another example of how Link-Belt total engineering works for you. Here is a nation-wide organization that will follow through from start to finish—design—manufacture, erect a complete materials handling system. Get all the facts from the Link-Belt office nearest you. Link-Belt engineers will be glad to work with you and your consultants.

LINK-BELT

BELT CONVEYOR EQUIPMENT

PICKING BELT CONVEYOR is fed crushed ore (from 400 ton ore pass) by Link-Belt manganese steel apron feeder (rear). Tramp metal is removed by electromagnet over discharge end of belt.

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 15.221

— IS NORTHWEST'S BEST SALESMAN!

Magnetite is tough digging. Four years ago Texada Mines Ltd., on Texada Island, north of Vancouver, B. C., replaced other equipment with two Northwest 80-Ds and cut the cost of operation by $2.00 an hour. Performance like this is Northwest's best salesman.

Two more Northwest 80-Ds have been added to the Texada Mine equipment — two repeat orders that make a practical endorsement mere words can't equal.

These Northwests are *real* Rock Shovels! They bring you the stamina for tough mining operations. The Northwest Dual Independent Crowd utilizes force most other independent crowds waste, giving that extra push for hard rock work. The Feather-Touch Clutch Control makes operation easy without pumps, compressors, valves, or tubing. The Cushion Clutch eliminates overloads before they can damage operating machinery. Cast steel bases and machinery side frames take the shocks of rock digging. Uniform Pressure Swing Clutches eliminate the jerks and grabs that make spotting heavy loads difficult. These and many other Northwest advantages combine to make the Northwest a *real* Rock Shovel.

If you have a pit problem or are modernizing, get complete details on Northwest equipment. Ask to see a Northwest man.

NORTHWEST ENGINEERING COMPANY
135 South LaSalle Street, Chicago 3, Illinois

TWO MORE NORTHWESTS

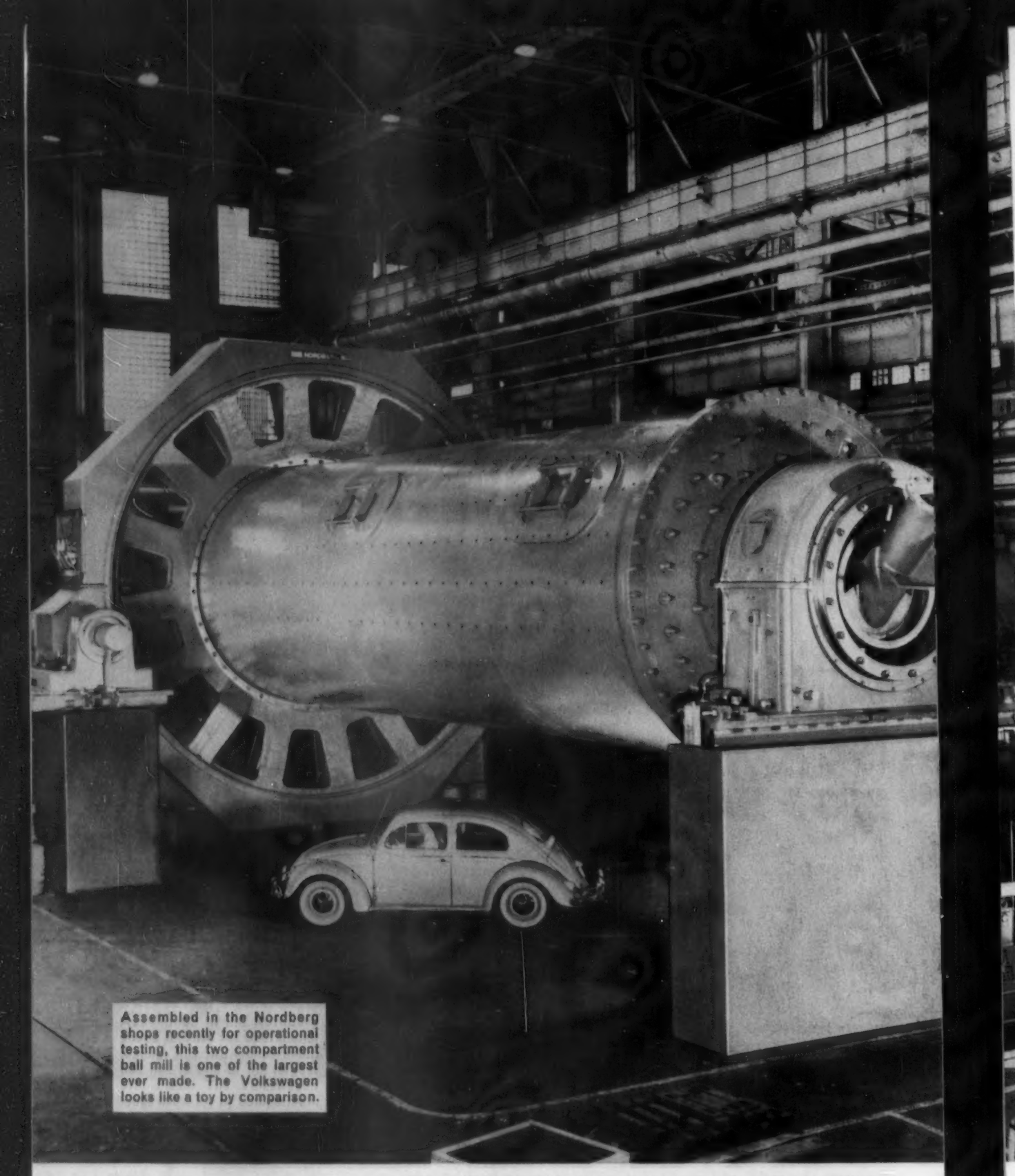
go into Magnetite
for
TEXADA MINES, LTD.
British Columbia

CRANES
SHOVELS
DRAGLINES
PULLSHOVELS
TRUCK CRANES

3/4 to 3 Cu. Yd. Capacity

NORTHWEST

S-80-96

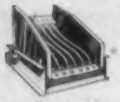


Assembled in the Nordberg shops recently for operational testing, this two compartment ball mill is one of the largest ever made. The Volkswagen looks like a toy by comparison.

SYMONS PRIMARY GYRATORY CRUSHERS

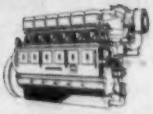
SYMONS® CONE CRUSHERS

SYMONS VIBRATING SCREENS



SYMONS VIBRATING GRIZZLIES

ROTARY KILNS and COOLERS



NORDBERG ENGINES

NORDBERG sets the pace in LARGE GRINDING MILLS

to turn out greater tonnages at lower cost per ton

Nordberg has recently completed five of the largest grinding mills ever built for industrial service. These two compartment Nordberg ball mills (see opposite page) are 12 feet in diameter by 36 feet long, each powered by a 2500 hp synchronous motor, operating at 10% beyond rating. These mills are being installed in a new 5 million barrel per year wet process cement plant. The economies of using very large grinding mills to turn out greater tonnages at lower cost are important, however, to many other large ore and mineral reduction processes, as well.

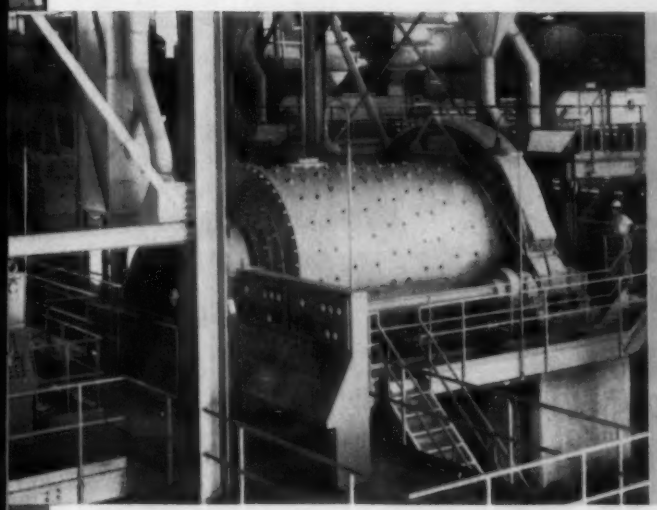
Consider some of these basic advantages:

1. *Lower construction and installation costs* . . . A single, large mill requires less floor space than several smaller ones, and only one foundation is required. Thus, construction costs are lowered and, in most cases, production is increased.

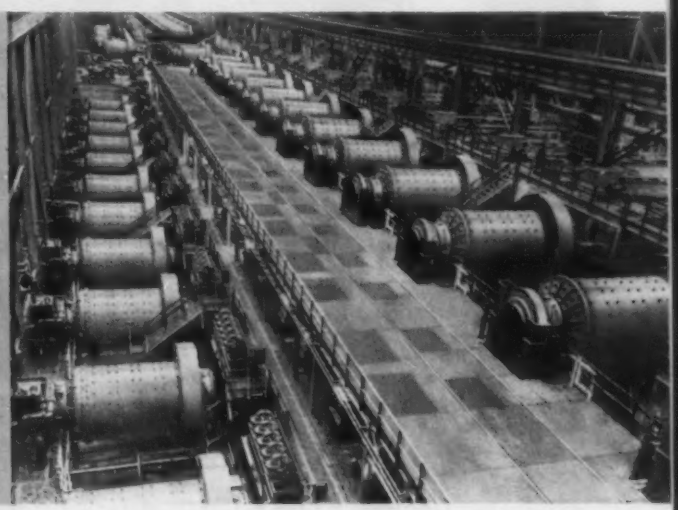
2. *Simpler automatic operation* . . . Where automatic operation is required, larger mills permit simpler handling with fewer controls. This lowers initial investment and minimizes installation and operational problems of automatic controls.

3. *Less maintenance* . . . Here, costs are again related directly to the number of mills installed. Fewer units mean less wearing parts and more dependable production. Exceptional savings may also be realized in replacement liners alone.

These are significant reasons behind the current trend toward larger grinding mills. But whether you require large or small grinding mills, you can count on the proven experience of Nordberg in furnishing the right grinding mill to meet your specific needs . . . including Rod, Ball, Pebble, Tube and Compartment types, in sizes from 6 to 13 feet in diameter and up to 50 feet in length. *Write for further information.*



Shown here are two of five 11′ x 17′ Nordberg Ball Mills—three raw and two finish—installed in a midwest cement plant that has a capacity of 3,000,000 bbl. annually.



The largest iron ore mill installation in the world with 58 Nordberg Grinding Mills. This concentrator building houses 27, 10′ x 14′ rod mills and 27, 10′ x 14′ ball mills. Four Nordberg mills serve as standby units.

NORDBERG MANUFACTURING COMPANY, Milwaukee 1, Wis.

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NORDBERG

SYMONS . . . a registered Nordberg trademark known throughout the world.

SYMONS SCREENS NORDBERG

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
SAN FRANCISCO • TAMPA • WASHINGTON • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

E&MJ OUTLOOK

ENGINEER'S FIELD REPORT

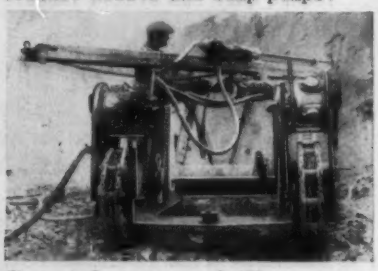
PRODUCT **CHEVRON VISTAC OIL**

FIRM **NEVADA-MASSACHUSETTS COMPANY**
Tungsten, Nevada

Special Oil holds wear to minimum for 15 yrs.

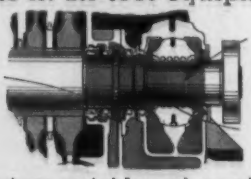
Nevada-Massachusetts Co., operators of one of the world's largest tungsten mines, has relied on Chevron Vistac Oil for 15 years, to keep their rock drills and other air tools operating at peak efficiency. "We use Vistac because it stays on the tools whether they're wet or dry. Doesn't create drag, either...we get full power with minimum tool wear," says general manager Eldridge Nash. Oil's tough, protective film resists high operating temperatures, helps this firm's rock drills (above) bore fifteen 2½-inch blasting holes averaging twelve feet in depth, in just eight hours. Nevada-Mass. does extensive underground mining at this site as well as surface operations.

Despite heavy abrasive dust from drilling in Hornfels and Scheelite, (above), Chevron Vistac Oil keeps rock drills working smoothly. Lubricant is used in 60 rock drills, 3 wagon drills, plus 25 tuggers (air motors) on hoist equipment, loaders, slusher hoists and sump pumps.



Special wagon drill, built at mine, uses Ingersoll Rand DA 35 rock drill to bore horizontal holes up to 18 ft. deep. EIMCO air motors lubricated with Chevron Vistac Oil power tracks for fast and easy maneuvering.

Why Chevron Vistac Oil cuts costs in air-tool equipment



- Atomizes quickly and completely—carries evenly over all parts. Prevents excessive fogging and has no unpleasant odor.
- Additives help form tenacious, oily, pressure-resistant film in wet or dry conditions—cuts wear and power loss.
- Resists high temperatures and oxidation. Stays fluid at low temperatures.

For More Information on this or other petroleum products, or the name of your nearest distributor, write or call any company listed.

CHEVRON Industrial Lubricants

TRADEMARKS "CHEVRON," "VISTAC" AND CHEVRON DESIGN REG. U.S. PAT. OFF.

STANDARD OIL COMPANY OF CALIFORNIA, 225 Bush Street • San Francisco 20, California

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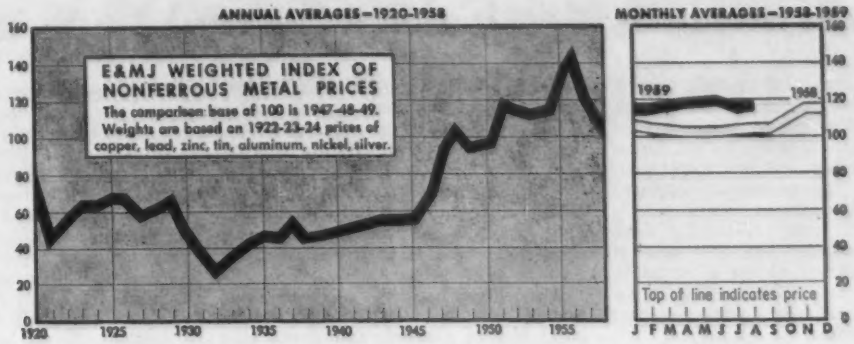
E&MJ OUTLOOK

PRICES



MARKETS

E&MJ's nonferrous metal price index rose slightly from 118.9 for July to 119.0 for August. Increases in the price of lead and silver were offset by a drop in copper and tin prices.

•

AT HOME

Directors of Joy Manufacturing Co. and Western Precipitation Corp. have agreed upon a plan whereby Joy would acquire net assets of Western Precipitation subject to approval by Western's stockholders.

Senate Interior Committee approved a bill introduced by Senator Frank Moss to authorize issuance of prospecting permits for phosphate on federal land. Another approved bill, offered by Senator Alan Bible would permit issuance of patents on 5-acre mill sites on placer claims. The present laws permit such patents for mill sites on lode claims only.

Wah Chang Corp. will install a second electron-beam furnace at its Albany, Ore., plant. Electron beam melting makes it possible to cast ingots of high purity tungsten, tantalum, columbium, beryllium, molybdenum, vanadium and their alloys; metals whose melting points lie in the 4,000 to 6,000 F range.

Business observers expect 1960 steel consumption to be about 120-million ingot tons.

American Zinc Institute announces the publication of a 700-page monograph, "Zinc—the Science and Technology of the Metal, its Alloys and Compounds". It is considered to be the most definitive source book on the subject ever published. It may be obtained from AZI or Reinhold Publishing Co. for $19.50.

•

LABOR

A two-year contract between Local 837, International Union of Mine, Mill and Smelter Workers and United States Metals Refining Co., subsidiary of American Metal Climax, Inc. has been ratified. It will assure continuing operation of the company's Carteret, N.J., smelter and refinery through June 30, 1961. Settlement includes a general wage increase of 7c per hr retroactive to July 1, 1959, and a further 7c increase to become effective July 1, 1960.

•

ABROAD

Aluminum Co. of Canada, Ltd., will suspend operations of magnesium ingot plant at Arvida indefinitely. The plant has an annual capacity of 4,000 tons.

Britain recently demonstrated a fuel cell, a gas-charged battery, operating on hydrogen and oxygen, powerful enough to run a lift truck. The fuel cell is made of porous nickel electrodes suspended in a caustic potash solution. British engineers predict that the fuel cell will be used to power electric trains and buses.

Dow Chemical Co.'s subsidiary La Domincia, S.A., in Mexico, has completed a fluorspar flotation plant to produce acid-grade spar for domestic and export markets.

THIS MONTH IN MINING

World Uranium Men Take a Second Look at 1966

THE BRIGHT HORIZON of uranium production and nuclear power demand dimmed somewhat last month as various parts of the world began to take a longer, harder look at the future, and at the approaching deadline for government supported programs.

The voices, some optimistic, some gloomy, some outspoken, told tales of planned cushioning of the 1966 cutoff, present contracts secured, and fears for the period immediately following support program deadlines.

• In Johannesburg, South African uranium miners dispatched a mission to the other producing areas of the world "to establish a closer liaison . . . and investigate potential markets." In addition, the Council for Scientific and Industrial Research launched a comprehensive research program, including investigation of the production of salts and oxides as well as metal. Producers in South Africa now feel, with world expansion underway, "production is running ahead of requirements."

• In the U.S., more than 90% of the western miners met the AEC's July 31 deadline on ore reserves established Nov. 24, 1958, and AEC granted a two-month extension of the deadline "if, in the opinion of the AEC, the producer demonstrates reasonable justification for having failed to submit such data" previously. Failure to file the reserve data prohibits a miner from shipping ore to mills delivering concentrate to AEC between March 31, 1962 and Dec. 31, 1966.

(It is expected that the two-month extension will delay a number of mill contract signings, since the reserve data must be related to the 1966 contracts—Ed.)

• Uranium Reduction Co., at Moab, Utah, signed its amended concentrate purchase contract with AEC at an $8 per lb rate. The contract, for $248-million for deliveries through 1966, dates back to July 1, 1958, and provides for sale of 27,465,560 lb of U_3O_8 in concentrates.

• Newspaper accounts of the current European situation last month noted that British and French nuclear power adherents were being opposed by supporters of the more traditional forms of energy. The Euratom community has slowed its development program and delayed its requests for World Bank loans to start construction of reactors. England has slowed its reactor program and is looking again at the superabundance of coal on the Continent. France is eyeing its oil potential in the Sahara and holding back on the nuclear front. Latest sampling of European opinion is for a rising uranium demand "in the late 1960's."

• The U.S. AEC has abandoned its work on liquid fuel reactors and has announced that it will start, after considerable urging, a long-range thorium breeder reactor development program. Oak Ridge will administer the program.

• N. W. Richards, official of Pacific Power & Light Co., speaking at the dedication of Susquehanna Western's $5-million Riverton, Wyo. mill on Aug. 8, said present development programs may be producing power at a cost of seven mills per kilowatt hour in 10 years. The result of this would make nuclear power cheaper in some areas than fuels presently used, he said.

• In Russia, deputy minister Frol Koslov is reported to have told U.S. Admiral Hyman Rickover that Soviet scientists "had badly misled the economic planners on the cost of nuclear power."

But the South Africans (see above) feel they have some "insurance" against the coming pinches. The uranium plants, they note, will be fully amortized by the time government contracts expire, and besides, their own by-product gold production promises a source of income even if uranium does slack off badly.

The cost per pound of uranium produced on the Witwatersrand varies greatly. The following table, from the FINANCIAL TIMES (London) is based on first quarter reports: (one shilling equals 14c)

	Production (lb)	*Costs per lb* s.	d.
Hartebeest	260,711	17	2
Vaal Reefs	156,496	17	10
Buffels	199,814	20	3
Harmony	174,990	‡*24	7
Daggafontein	157,309	27	9
Virginia	162,574	28	11
Blyvoor	166,032	*30	6
Stilfontein	91,456	30	11
Freddies Cons	54,432	31	9
Welkom	70,790	32	6
Western Reefs	184,532	34	7
President Brand	63,883	34	9
President Steyn	75,828	35	10
West Driefontein	44,677	39	7
West Rand Cons	312,899	†39	7
Loraine	49,006	42	1
Ellaton	34,047	45	7
Dominion Reefs	138,188	†46	2
Vogels	52,857	‡50	0
Luipaards	192,190	†54	7
Doornfontein	25,656	69	7
East Champ d'Or	30,123	†*73	7
Randfontein	446,221	†*75	3

* Cost per lb. sold. † Mining costs included.
‡ Also covers pyrite costs.

Susquehanna-Western's 600-tpd capacity dual-process uranium mill and acid plant are located about one mile south of Riverton. Present production is about three barrels of yellow cake each three-day shift and the firm is currently negotiating with the AEC to boost its ore feed capacity to 725 tpd.

The acid plant, operated as a separate business by Susquehanna-Western Inc. Chemical Div., produces enough sulphuric acid to supply all the uranium mills in Fremont County in addition to Susquehanna's mill.

Construction on the mill and acid plant was started around the beginning of 1958. The plant went into production last November. Operating the mill and acid plant is a work force of 103.

Company officials also revealed that acid plant expansion is planned for the very near future. The expansion, to be completed with only a few minor modifications, would boost acid production from 100 to about 125 tpd. Acid not used in the firm's uranium mill is sold to other mill operators.

Susquehanna-Western engages only in custom milling at Riverton, processing ore for a number of mines in the area since it does not control any ore reserves. The plant is operating under an AEC contract which runs through 1966.

Uranium Reduction Co. already has started construction on the $2.5-million alkaline leach circuit at Moab. Western Knapp Engineering, San Francisco, has the contract and M. R. Melich said completion is scheduled by Jan. 1, 1960.

The uranium firm executive also announced that ore purchase contracts in line with the Ureco-AEC concentrates sales agreement had been signed with major mines in the Big Indian area. They include Hidden Splendor Mining Co., Lisbon Uranium Corp., Mountain Mesa Uranium Corp., Hecla Mining Co. and Radorock Resources Inc. (jointly);

Asarco Announces Start of Mission Project

A $43.5-MILLION COPPER MINE and mill will be producing approximately 1,500 tpd of copper concentrates sometime in 1962 when American Smelting & Refining Co.'s Mission Project, in Arizona, is completed.

The Asarco board of directors appropriated the funds last month to develop the mine property in Pima County, about 15 miles southwest of Tucson. The mine, scheduled to be an open pit covering about 250 acres, is partially in the San Xavier Indian Reservation and near Pima Copper. Asarco's other property in Arizona, the Silver Bell pit, lies 40 miles north of Tucson.

Asarco has been exploring the Mission Project since 1954 and during the past five years a total of 346 drill holes have been sunk with a total length of more than 190,000 ft. To check the diamond drilling results and to obtain bulk samples for pilot mill tests, a 375-ft shaft was sunk and drifts, crosscuts and raises totaling more than 2,200 ft were driven in the ore zone. The underground work confirmed the satisfactory potential of the orebody.

In the mineralized areas, bedrock is overlain by about 200 ft of gravel wash which is amenable to low cost stripping. Present plans call for smelting the mill concentrates at Asarco's Hayden and El Paso plants and for refining at the company's Baltimore and Perth Amboy refineries.

Charles A. Steen's Utex Exploration Corp. and Homestake Mining Co.'s subsidiary La Sal Mining & Development Corp.

Ureco also has signed a contract with Standard Uranium Corp. covering pounds of U_3O_8 in ore to be delivered from reserves established prior to a major discovery in Standard's Big Buck mine in the Big Indian area.

This discovery was made prior to the Nov. 24, 1958 deadline and the AEC and Standard are in negotiation on allocation of ore from the new discovery area in conformance with the agency's 1962-1966 concentrates buying program.

Mr. Melich said the addition of the alkaline leach circuit and other improvements in technology would permit Ureco to be competitive in the post 1966 uranium concentrates sales picture. He expressed the belief that AEC would buy uranium concentrates from domestic producers after 1966, as well.

(*Continued on p 190*)

Mining Calendar

Third Industrial Nuclear Technology Conference, Chicago, Ill. Sponsored by Armour Research Foundation and Nucleonics magazine, Sept. 22-24.

International Symposium on High Temperature Technology arranged by Stanford Research Institute, Asilomar Conference Grounds, Calif. Oct. 6-9, 1959.

Ninth Annual Exploration Drilling Symposium, Pennsylvania State University, University Park, Pa. Oct. 8-10.

Eighth National Clay Conference, University of Oklahoma, Norman, Okla., Oct. 12-14.

AIME-ASME Joint Solid Fuels Conference, Netherland-Hilton Hotel, Cincinnati, Oct. 27-29.

Fifth Symposium on Mining Research, Missouri School of Mines, Nov. 19-20.

Annual meeting, AIME, New York, Feb. 14-18, 1960.

Australasian Institute of Mining & Metallurgy, Adelaide Branch, Symposium on Hydrometallurgy, "Wet Processing of Minerals and Industrial Products," Feb. 16-19.

Symposium on Pilot Plants in Metallurgical Research and Development, Jamshedpur, India, February.

Fifth International Mineral Processing Congress, Westminster, London. The Secretary, Institution of Mining & Metallurgy, 44 Portland Place, London, W.1, England. April 6-9.

International Congress on Research into Ground Control and Rock Mechanics, Paris, France. May 16-20.

Wyoming Mining Association, Jackson Lake Lodge, Wyo. June 10-11.

XXI International Geological Congress, University of Copenhagen, Denmark. American Geological Institute, 2101 Constitution Avenue, N. W., Washington 25, D.C. Aug. 15-25.

(*This Month continues on p 132*)

As We Went to Press . . .

A Japanese mission, representing the four leading iron and steel companies of that nation, was dispatched Aug. 27 to survey the potential of southern Alaska as a source of iron ore.

Utahcan Mines, Inc., of Spokane, Wash., planned to have its mill near Ione in operation by Sept. 1. The 150-ton mill will concentrate lead-zinc ore, along with some silver and gold from an open pit about a half mile from Ione. Concentrates will go to Bunker Hill's Kellogg smelter.

A $30-million aluminum industry, bauxite-to-aluminum, will be constructed in India by the G. D. Birla interests and Kaiser Aluminum & Chemical Corp.

Capacity of the aluminum plant would be 20,000 metric tons, with operations to begin in 1962. Kaiser Engineers will design the facilities, which will draw power from the Rihand Dam and bauxite from Amarkantak.

Stockpile disposal, in one form or another, is coming. OCDM director Leo A. Hoegh testified before a Joint Congressional Committee that his office has drafted a bill to create a "Materials Reserve Stockpile," from which disposal could be made without specific Congressional authority. Washington observers see no chance for the bill this year, and even less in 1960 (an election year), but the decision to seek eventual disposal authority of the $8-billion worth of materials which the Administration considers "excessive" has been made.

In other Washington news, the approval of the Senate Agriculture Committee of an expansion of PL 480, the Crop Disposal Law, to three years' term instead of one, while reflecting Congressional interest in the program, does not change the present barter aspects of the law.

Overexposure to radiation is common in nearly two-thirds of the uranium mines in the U.S., according to the Public Health Service. Assistant Surgeon General David E. Price said 64% of Colorado Plateau miners were found to be exposed to radiation levels at least five times higher than "the desirable working standard."

The House passed the Aspinall resolution, calling on the Administration to review existing Federal mining support programs and to improve them. Senate approval is expected, but the resolution has no force of law.

Two minerals agreements were altered last month. GSA was relieved of its obligation to buy about 26-million lb of nickel from International Nickel Co. Inco will sell the metal in the open market, being reimbursed by GSA for that which comes from high-cost marginal ores. Payment will be in nickel oxide sinter.

Lithium Corp. of America announced that its raw materials contract with Quebec Lithium Corp. for deliveries of spodumene ores to the Minneapolis firm has been terminated. Quebec Lithium, through president Pierre Beauchemin, denied termination of the agreement, and said LCA is "obligated to purchase . . . 17,000 units of concentrates every month up to March 1, 1962."

WASHINGTON IMPACT

Highlights

TARIFF COMMISSION STUDIES—The key phrase in the Senate's directive to the Tariff Commission, ordering studies of the effects of imports on domestic lead-zinc and fluorspar mining industries, is the request for "specific findings of fact." This is the first time the Commission ever has been required to take a position for or against new import restrictions in its reports on a domestic industry under Section 332 of the law.

Section 332 is the seldom-used provision under which the Congress, or the Commission itself, may initiate a study of the overall market situation confronting a domestic industry. Unlike the Commission's "escape clause" investigations, and other specific considerations of a petitioner's problems with import competition, Section 332 studies traditionally do not result in any recommendations.

The call for a specific stand on higher duties or tighter quotas on lead-zinc and fluorspar is a procedural victory for the Senate mining-state "bloc." Earlier, 15 Western and Southern Senators had asked the Tariff Commission to look into imports of lead-zinc products, and review existing quotas on ores and concentrates. The Commission, with White House backing, instead announced on its own a regular Section 332 study of lead-zinc products alone.

However, mining-state Senators pushed their point. They won support first from the influential Senate Finance Committee, which includes metal-mineral-minded members Robert S. Kerr (D-Okla.), Clinton P. Anderson (D-N.M.), and Wallace F. Bennett (R-Utah). Then they got Tariff Commission cooperation and informal acquiescence. Finally, the Senate voted the studies.

The mining "bloc's" strategy is clear. Earlier Tariff Commission escape clause reports on lead-zinc have urged tighter restrictions against imports than the President accepted. More important, the political pressure for tighter curbs on import trade is bound to gather steam by next spring—when the Commission reports on lead-zinc and fluorspar are to be filled—as part of the election-year campaign climate.

Should the Commission not back mining-state Senator's efforts for additional import restrictions, there will still be time to try again for direct Congressional action.

MUELLER ON METAL-MINERAL POLICY—Commerce Secretary Frederick H. Mueller went on record more explicitly as to domestic mining policy than any cabinet officer in recent history, excepting of course Secretaries of Interior. Reason: as Undersecretary he had stirred up a hornet's nest of reaction on Capitol Hill to his "everything's dandy" letter in response to a House (Aspinall) Resolution calling for an Administration review of its metal-mineral policies and programs (E&MJ, August 1959, p 22.)

At Senate Interior Committee hearings and a maiden press conference shortly after he was sworn in, Mueller made these statements:

- He personally favors extending existing lead-zinc quotas to products (see above), even though they account for only 4% of lead-zinc imports, but he does not speak for the Administration on this score.
- He concedes lead-zinc is one of the "soft spots" in the current mining industry economy, and believes there are others.
- He feels the existing lead-zinc import curbs have not yet had a fair trial, or time to work their full effect on supporting domestic prices, which he believes will improve gradually.
- All metal-mineral commodity problems should be considered on a case-by-case basis, and he does not believe in basing over-all trade policy on considerations of any specific industry segment. The U.S. economy is so big that no one specific industry setback can hurt it for very long.
- Where Congressional action to restrict imports is "inevitable," the Administration should try to do something first.
- Stockpile disposal should be managed so as not to "materially" affect current market price, and disposal should be made in time of a rising business cycle.

Barter Outlet for U.S. Ores Loses in House

THE HOUSE voted down an expanded barter program which would have permitted domestically mined metal and mineral ores to find new markets in Agriculture Department's supplemental stockpile in exchange for U.S. surplus crops.

The new program would have accepted domestic lead, zinc, manganese, tungsten and chrome—primarily in the form of ferroalloyed products.

As finally voted by the full House, and as provided in the Senate version, the Agriculture Department's minerals-for-crops swapping program will be extended for another year at present $150-million limits, and with existing restrictions, which have slowed barter to a walk in the last two years.

Actually, the barter expansion provision was a "sleeper," written by the House Agriculture Committee without the knowledge, much less at the instigation, of domestic mining-state legislators. Here's what happened:

Barter, as provided in Title III of the over-all U.S. Surplus Crop Disposal Law, PL No. 480, has consisted of the swapping of domestic crop surplusses for foreign strategic metals and minerals since it was first written into the books in 1954. The practice grew until early in 1957, when objections were raised that barter deals were displacing normal commercial sales of domestic farm products. U.S. allies who exported large quantities of agricultural goods also complained.

The result was that Agriculture two years ago drafted tightly restricting regulations which curtailed barter volume severely. Since then, attempts to restore active barter in Congress have failed.

The barter program has been criticized and praised by different segments of different industries and Government agencies. Some farmers raised original complaints about inroads on normal markets. Grain brokers have sharply criticized the program, while metal-mineral traders favored it before restrictions imposed in 1957 created what they since have said is too much red tape to make the program worthwhile for them.

Domestic mine interests have alternately lauded barter as a way of draining off foreign metal-mineral surplusses which depress world markets, and slapped at it as a program that encouraged foreign over-production. Metal-mineral processors are also divided between those who benefitted from smelting or refining foreign ores for the stockpile, and those who handled only domestic ores.

Rep. Harold Cooley (D-N.C.), of the House Agriculture Committee, this year successfully won his group's support of an expanded program which would have

encouraged barter of up to $350-million of crops for minerals for three years, and removed many of the restrictions now curtailing the program—including one which requires brokers to submit evidence that their barter deals are "additional" to normal commercial sales.

In drafting the language for the expanded program, the House Committee also took note that some processors complained they used to be allowed to offer domestically processed products of foreign ores for barter (provided the U.S. processing added no more than 50% of the total value)—but could no longer under present rules.

In effect, the House Committee — vaguely aware that domestic mines also were complaining that Government stockpile purchase programs were running out—suggested that domestically processed and domestically mined metals and minerals be made eligible for swapping in exchange for surplus crops.

The innocent "sleeper" was objected to on the House floor, however, and went down to defeat along with the rest of the amendments designed to bring barter to 1956 levels.

Foreign Activity by U.S. Mining Firms Increases

OVERSEAS ACTIVITIES are being stepped up by domestic mining companies, following a pattern set by U.S. industry generally. Foreign private investment is increasing, and sales for subsidiary companies abroad are expected to outpace exports for all domestic companies with overseas ties, as well as for metal-mineral producers.

These are the highlights of a new survey by the McGraw-Hill Economics Department, which carry investment and trade trends reported by the U.S. Departments of Commerce and Interior in Washington still further.

This year, primary metals producers plan to spend close to $133-million overseas, up 4% over last year. In 1960, however, the figure may drop to $96-million (See February 1959, p. 89).

Export sales, trending up for most manufacturers, are due to drop 10% over the 1959-60 period for primary metals, down to $820-million from $908-million last year. But sales of overseas operations—due to rise 7% and 9% over this year and another 20% next year for primary metals producers.

Primary metals investment outlays this year are concentrated, ironically, in Europe and the underdeveloped areas of Asia and Africa. In Europe, producers are boosting their spending from less than $2-million to nearly $14-million, and will up that to about $25-million next year. In underdeveloped areas, outlays will go from slightly over $12-million last year to $15.5-million this year, $16.5-million in 1960. Canadian and Latin American investments will decline over the same period.

Labor This Month

WAGE SETTLEMENTS—BEFORE STRIKES: While the nonferrous and steel strikes held the spotlight, 1959 negotiations went rolling along. Government figures, for the first six months, show some 1.9-million workers have collected negotiated increases. Pay hikes from seven to nine cents went to nearly 1-million. The spread ranged from 5- to 15c. Here's what's happening industry-by-industry: petroleum refining, 13.5c; pulp and paper, 7c; utilities, 10- to 13c; cement and textiles, 10c; chemicals, 8c. The front-runner, as usual, is construction, with 14.3c averages. On top of these flat pay hikes, higher fringe benefits were paid 69% of all new contracts.

THREE YEAR LABOR COSTS: New fodder for the bargaining table also is revealed in Federal figures on what the big industries have been paying out since 1956. Including cost-of-living payments, the steel industry wage rates have advanced 45.7c—or a total of 20.3%. This compares with General Motor's 44.5c. Alcoa's 51.6c; Lockheed's 46.1c; Sinclair Refining, 44.2c and the 28.7c paid by the rubber industry. For the nonferrous mining industry, pay costs have risen over the past three years by 23.6c.

BACK TO THE "HOUSE OF LABOR": The first attempt by an expelled union to return to the AFL-CIO is in the works. The International Longshoremen's Association, kicked out of the federation for racketeering six years ago, is going back in—on probation. In a plan worked out between ILA leaders and AFL-CIO president George Meany, the dock workers union would rejoin the federation on a trial basis. All its activities would be checked by an AFL-CIO watchdog committee for two years. Then, re-affiliation could be made permanent.

The plan has important ramifications for the Mine-Mill and Smelter Workers and others ejected in the past. If the ILA deal works, it may be tried elsewhere. Mine-Mill's route would be more difficult, however. Its expulsion was on grounds of Communist domination. Meany would most likely require a thorough overhauling of Mine-Mill leadership—something MMSW shows no enthusiasm for at this point. Still, there's no doubt the AFL-CIO is attempting to rebuild the federation. It is disillusioned with the expulsion process, mostly because of the Teamsters Union, which has thrived outside the merged labor movement.

LABOR FLIRTS WITH TARIFFS: Union leaders are showing a new concern over imports—and their threat to union jobs. As the leading spokesman for organized labor, the AFL-CIO has traditionally supported the reciprocal trade agreements. But its affection for the free trade route is diminishing. The change showed up in an appeal by five needle trades unions, including the garment and clothing unions, to put import curbs on products from low wage countries. They asked the AFL-CIO executive council to adopt a resolution that said the Government should set prevailing production rates for domestic industries. Until the industries reach these levels, tariffs should be placed on competitive foreign goods which are produced with "substandard" wages.

The council declined to buy the resolution immediately, on the appeal of United Auto Workers president Walter Reuther who objected to a shift in the AFL-CIO free trade position. However, some change may be coming. The union leaders turned the import problem over to labor economists for study and a recommended solution.

LABOR BOARD HITS CASE BACKLOG: New campaigns are under way at the National Labor Relations Board to cut into the cases piling up for solution. Management and labor have complained at the length of time—frequently more than a year—it takes to process an unfair labor practice complaint. As of June a total of 7,660 cases were awaiting solution.

Both the five member Board and the independent NLRB general counsel are working on solutions. Board members have set up a special committee to revise its rules "to streamline and expedite" disputes before the Board. And it's new general counsel, Stuart Rothman, is riding herd on regional offices to process cases faster. He has cut their time to process cases from a 90-day total to 45 days.

MARKETS

Copper Output Cut 75% by Strikes. Lead Also Hit Hard; Price Raised 1c.

E&MJ's index of non-ferrous metal prices in August was 119% of the 1947-'49 average; July was 118.9%. The drop in the monthly average price of copper to 29.893c from 30.077c was offset by the rise in lead to 12.286c from 12c.

About three-quarters of U.S. copper mining, smelting and refining were struck by the end of August. Phelps Dodge's Laurel Hill refinery was struck August 1 by the United Steelworkers; it had been producing about 14,000 tpm. Its El Paso refinery, which had been producing about 22,000 tpm, was struck by Mine-Mill August 20 along with its mining and smelting facilities at Douglas, Bisbee, and Morenci in Arizona, and Los Angeles. Its facilities at Ajo, Arizona were closed for vacation August 22 and a strike was uncertain. The company's mining output has probably been cut back by about 17,000 tpm.

Kennecott's Western Mining division was struck by Mine-Mill August 10. The United Steelworkers also struck. The company had a mine output of about 33,000 tpm. Its Garfield refinery had been refining about 17,000 tpm and its fire refining at Chino had been at about 6,500 tpm.

Anaconda's Montana and Tooele, Utah copper properties were struck, mainly by Mine-Mill, August 19. It is losing about 7,000 tpm. Yerington, in Nevada, continues to operate. Its subsidiary, Inspiration Consolidated Copper Co. which has been producing about 3,000 tpm and its Miami, Arizona refinery also operate. Anaconda's refinery at Raritan, which has been refining mainly copper from its Chilean properties, does not have union contract termination until November 10.

San Manuel was struck by Mine-Mill in Arizona August 11—it had been producing about 8,000 tpm.

Asarco's properties were struck by Mine-Mill August 20. Included were its copper smelters at El Paso, Hayden, (Arizona), and Tacoma, and its refineries at Baltimore, Perth Amboy, and Tacoma. The company has no copper smelters or refineries operating in the U.S.

American Metal's copper refinery at Carteret, New Jersey, as in past years, settled with the union. Mine-Mill gets 7c per hour wage increase from July 1, 1959 and another 7c increase July 1, 1960. A new pension plan and other fringe benefits are calculated at about 7.6c per hour.

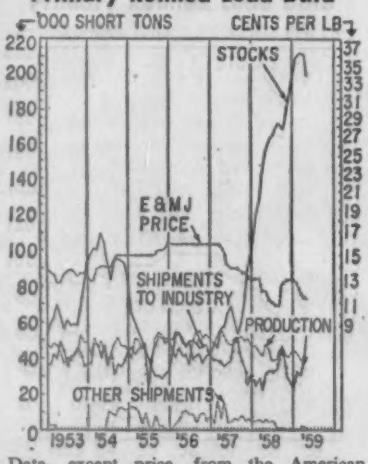
Calumet and Hecla signed a two year contract with USW.

Copper prices firmed as the strikes developed. Major producers in the U.S. stayed with the 30c delivered price but other sellers in the U.S. and abroad raised. In mid-August custom smelters raised from 29½c delivered to 30c but held at that price until late in the month. Dealers, with prices closely related to the N.Y. Commodity Exchange and the London Metal Exchange, raised. By the middle of August they were at about 33c. With speculating on the exchanges and some short covering pushing exchange prices up dealers raised to about 33½c August 31.

Two U.S. custom smelters withdrew from the market as their regular supply of copper was stopped. The other one, American Metal Climax, which also acts as sales agent for other firms and which is a major owner of African mines, announced a 33c delivered price in the U.S. Copper had been sold at 32½c delivered. Katanga upped its price to 29½c main European ports.

Though Copper Association data showed fabricators in the U.S. had more than 500,000 tons in inventory, most of this was in the form of fabricated products or copper in process. Many fabricators indicated they had enough to keep their mills going for six weeks or two months but a few were not so well covered. Analysts felt that with U.S. producers able to supply very little copper the volatile markets outside the U.S. would determine prices every where. Copper bought by U.S. fabricators, whether from U.S. or foreign sellers, would get more expensive the longer the strikes continue. Sellers in Europe, except Katanga, price most of their copper on the LME and as the strikes continue the LME will move up—little copper will be available in the U.S. at less than LME prices. Anaconda's Raritan refinery has been largely supplying Chilean copper to Europe and few doubt there will be a change in this.

Primary Refined Lead Data



Data, except price, from the American Bureau of Metal Statistics. "Other Shipments" refers to shipments to the U.S. Government. The price is the *E&MJ* weighted average, N.Y. Data through June.

Lead was raised to 13c a lb New York and 12.8c St. Louis by St. Joe August 24; other sellers followed. With the strike against Asarco most lead production is stopped. St. Joseph lead Company and Bunker Hill continue to operate. Lead stocks held by producers in the U.S. are still extremely high. Many observers feel much of this lead cannot be shipped owing to the strike and that if the strike continues prices could rise more. Some suggest that unless it lasts two months prices could fall at the end of the strike.

Zinc sales of Special High Grade have been good. In part this results from the view the strikes in copper and lead might hit more zinc firms. The sharp demand for die-casting zinc gave sellers the opportunity to raise prices. New Jersey Zinc announced that effective September 2 new prices would obtain for Special High and High Grade and for no. 3 and no. 5 alloys. Each is up ¼c a lb. Orders received September 1 for September and October delivery will be filled at the lower prices. The new prices are 1½c for Special High and 1¼c for High Grade (premiums over Prime Western). No. 3 alloy is 14¼c and no. 5 is 14½c a lb.

Asarco made the new prices effective immediately—Aug. 31. Anaconda made the change Sept. 2; others Sept. 1. The weighted average Special High premium was 1.43c and High Grade 1.15c on Sept. 1.

Six large U.S. zinc and lead smelters have requested the U.S. Government to abandon import quotas on lead and zinc and to use higher import duties to protect industry. The six companies are Asarco, American Zinc, Athletic Mining and Smelting, Blackwell Zinc (American Metal), Matthiessen and Hegeler and National Zinc (International Minerals and Metals).

The statement said the import quotas have caused "major dislocation of lead and zinc raw material supplies" and "financial hardships and metallurgical difficulties to the domestic smelting industry."

A controversy has existed between firms that are essentially mining with those that are primarily smelters. The latter need ore from abroad as well as from domestic sources and the reference to "major dislocation" in their statement implies that they would like to get more foreign ore. The last point in the statement referred to the difference between the import duty on metal and that on the corresponding ore—smelters wish a larger spread than miners. The lower the smelter operating rate the higher the needed spread between ore and metal prices in order for them to make a profit. Smelters need to keep the operating rate high. The reference to "dislocation" probably has this in mind, at least in part. All quotas and import duties "dislocate" supplies—that is the method by which they obtain the desired results. But no dislocation will be the desired one for everyone.

Average Prices August (E&MJ Quotations)

Copper:

Electro, domestic refinery	28.893
Electrolytic, export refinery	28.270
Electrolytic, c.i.f. Cont'l ports	29.215

Lead:

Common, New York	12.286
Common, St. Louis	12.086

Silver:

Silver, New York, per oz.	91.399
Silver, London, pence per oz.	78.844

Zinc:

Prime, Western, East St. Louis	11.000
Prime, Western, delivered (g)	11.500

Tin:

New York Straits	102.327
Gold, per oz., U. S. price	$35.000
Sterling Exchange	280.950
Quicksilver, per flask	$229.381
Antimony (E&MJ) (d)	32.590
Antimony, bulk, Laredo	29.000
Antimony, in cases, Laredo	29.500
Platinum, refined, per oz.	$77.000
Cadmium (a)	120.000
Cadmium (b)	130.000
Al., 99½ dom., ingot	26.800
export, pig	22.500
Magnesium, ingot	35.250
Nickel (f)	74.000

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.
(a) Per lb. delivered, ton lots.
(b) Per lb. delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.

Free Gold Market

The volume of international gold transactions declined 18¾% in August. London and Paris led in turnovers but with reduced dealings and fractionally lower prices. Coin tendencies were mixed with Bombay higher and Djarkarta jumping sharply on currency troubles. Bar prices rose generally in continental and Asiatic centers. The U.S. gold outflow continued but at a slower rate. No Soviet gold sales were reported. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	July 31	Aug. 31	July 31	Aug. 31
NEW YORK transit	.....	.....	$35.08¼	$35.08¼
MANILA	$42.00	$41.85	36.00	36.00
HONG KONG	46.40	46.00	37.50	38.45
BOMBAY	57.50	59.00	56.00	57.50
TANGIER	40.55	40.35	35.25	35.25
BEIRUT	40.60	40.50	35.18¾	35.18¾
PARIS	40.50	40.50	35.47¼	35.45
BUENOS AIRES	38.75	39.60	35.05	35.25

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Custom Smelter Copper Price

Based on flat price and E&MJ average prices sales in U. S. for month of August reported by American Smelting & Refining Co.; electrolytic copper in standard shapes, adjusted to nearest ⅛c; ¼c deducted for selling common.

Delivered Consumers' plant	29.750 lb
F.o.b. refinery	29.350 lb

Major Metals

U. S. DAILY AND AVERAGE PRICES

Aug. 1959	Electrolytic Copper (a) Domestic	(b) Export	Europe c.i.f. (c)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99% U. S. Dest.	Straits Tin New York
3	29.525	26.750	27.695	12.000	11.800	11.500	11.000	24.700	102.000
4	29.550	27.225	28.170	12.000	11.800	11.500	11.000	24.700	101.875
5	29.600	27.600	28.545	12.000	11.800	11.500	11.000	24.700	101.750
6	29.500	27.525	28.470	12.000	11.800	11.500	11.000	24.700	101.750
7	29.550	27.700	28.645	12.000	11.800	11.500	11.000	24.700	101.625
10	19.600	27.900	28.845	12.000	11.800	11.500	11.000	24.700	101.625
11	29.600	28.775	29.720	12.000	11.800	11.500	11.000	24.700	101.500
12	29.600	28.800	29.745	12.000	11.800	11.500	11.000	24.700	101.750
13	29.600	28.800	29.745	12.000	11.800	11.500	11.000	24.700	101.875
14	29.600	29.025	29.970	12.000	11.800	11.500	11.000	24.700	102.250
17	29.775	28.850	29.795	12.000	11.800	11.500	11.000	24.700	102.500
18	29.600	28.625	29.570	12.000	11.800	11.500	11.000	24.700	102.500
19	29.600	28.650	29.595	12.000	11.800	11.500	11.000	24.700	102.625
20	29.600	28.675	29.620	12.000	11.800	11.500	11.000	24.700	102.500
21	29.600	28.625	29.570	12.000	11.800	11.500	11.000	24.700	103.000
24	30.525	28.400	29.345	13.000	12.800	11.500	11.000	24.700	102.875
25	30.250	28.250	29.195	13.000	12.800	11.500	11.000	24.700	103.000
26	30.175	27.900	28.845	13.000	12.800	11.500	11.000	24.700	102.875
27	31.275	28.000	28.945	13.000	12.800	11.500	11.000	24.700	103.000
28	31.300	28.700	29.645	13.000	12.800	11.500	11.000	24.700	103.000
31	30.325	28.900	29.845	13.000	12.800	11.500	11.000	24.700	103.000
AVERAGES FOR MONTH									
Aug.	29.893	28.270	29.215	12.286	12.086	11.500	11.000	24.700	102.327
AVERAGES FOR WEEK									
Aug.									
5	29.555	27.285	28.230	12.000	11.800	11.500	11.000	24.700	101.825
12	29.570	28.140	29.085	12.000	11.800	11.500	11.000	24.700	101.650
19	29.635	28.790	29.735	12.000	11.800	11.500	11.000	24.700	102.350
26	30.030	28.370	29.315	12.600	12.400	11.500	11.000	24.700	102.850
CALENDAR WEEK AVERAGES									
Aug.									
7	29.545	27.360	28.305	12.000	11.800	11.500	11.000	24.700	101.800
14	29.600	28.660	29.605	12.000	11.800	11.500	11.000	24.700	101.800
21	29.635	28.685	29.630	12.000	11.800	11.500	11.000	24.700	102.625
28	30.705	28.250	29.195	13.000	12.800	11.500	11.000	24.700	102.950

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance, Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective April 9, 1958, commanded a premium of 1c per pound over the current market for Prime Western; Special High Grade 1.25c effective April 9, 1958.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U. S. lead is corroding grade).

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Aug. 1959	Silver (c) New York	Silver London	Sterling Exchange	Gold (d) London
3	91.375	Holiday	281.0900	Holiday
4	91.375	78.625d.	281.1250	249s. 10½d.
5	91.375	78.625d.	281.1500	249s. 10d.
6	91.375	78.625d.	281.1700	249s. 9¾d.
7	91.375	78.625d.	281.1600	249s. 10d.
10	91.375	78.875d.	281.0900	249s. 10d.
11	91.375	78.875d.	281.0900	249s. 10¾d.
12	91.375	78.875d.	281.1100	249s. 10d.
13	91.375	79.000d.	281.1100	249s. 10½d.
14	91.375	79.000d.	281.0500	249s. 10d.
17	91.375	79.000d.	281.0200	249s. 10d.
18	91.375	79.000d.	280.9700	249s. 10½d.
19	91.375	79.000d.	280.8100	249s. 11¼d.
20	91.375	79.000d.	280.8100	250s. ½d.
21	91.375	79.000d.	280.9000	249s. 11½d.
24	91.375	79.000d.	280.8500	250s. 0d.
25	91.375	78.750d.	280.8000	250s. ½d.
26	91.375	78.750d.	280.7100	250s. 1¼d.
27	91.375	78.750d.	280.7100	250s. 2d.
28	91.625	78.750d.	280.7100	250s. 1¾d.
31	91.625	78.750d.	280.5200	250s. 2¾d.
AVERAGES FOR MONTH				
Aug.	91.399	78.844d.	280.950	—
AVERAGES FOR WEEK				
Aug.				
5	91.375	—	281.103	—
12	91.375	—	281.124	—
19	91.375	—	280.992	—
26	91.375	—	280.814	—

Calendar Week Averages: New York Silver: Aug. 14, 91.375; Aug. 21, 91.375; Aug. 28, 91.425

MARKETS *(Continued)*

London Metal Exchange Quotations

Aug.	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
3	Holiday															
4	226	226¼	225¾	226	70¼	70½	71	71¼	82½	82¼	81½	81¾	793½	794	790½	791
5	225½	225¾	225	225¼	70¾	71	71⅛	71⅜	83¼	83½	82	82¼	792½	793	790	790½
6	226¾	227¼	226¼	226½	71⅛	71⅜	72	72¼	83¾	84	82¼	82½	792½	793	790½	791
7	228	228½	227½	227⅝	71½	71⅝	72⅛	72⅜	84	84¼	82⅞	83	792½	793	790	790½
10	235	235⅛	233¼	233½	71⅝	71⅞	72⅜	72⅝	84¼	84½	83	83¼	793	793½	790½	791
11	235¾	236	234½	234⅝	71⅞	71⅞	72½	72½	84½	84⅝	83	83¼	793½	794	790½	791
12	234½	234¾	234	234¼	71¾	71½	72¼	72⅜	85¼	85½	83⅛	83⅜	792¾	793	790½	791
13	236¼	236½	235½	235¾	72⅛	72½	73¼	73⅜	85¼	86	84½	84¾	792½	793	791	792
14	237¾	238	236	236¾	72½	73	73⅞	74	86½	86½	84⅞	85	793½	795	792½	793
17	235¾	236	233¾	234	73¼	73¾	73⅞	74	86⅛	86½	85	85¼	793	793½	793	793½
18	233¾	234	231¾	232	73	73¼	73⅞	74	86¾	86½	85¼	85½	792½	793	792½	793
19	234	234¼	231¾	232¼	72½	72¾	73¼	73½	86½	86¾	85	85¼	792½	793	792½	793
20	234	235	233	233¼	73	73¼	74	74¼	86¼	86½	85	85½	792½	793	792½	793
21	233½	233¾	231½	231¾	73⅛	73½	74⅛	74½	85¾	86	84½	84¾	793	793½	793	793½
24	231½	231¾	229½	230	72½	73	73⅞	74	84½	85⅛	83¾	84	792	793	792½	793
25	230	230¼	229	229½	72¾	73	73½	74⅛	85½	85¾	84	84¼	792	792½	792	792½
26	228	228¼	227	227½	71¾	71⅞	73¼	73½	84½	85	83⅞	83¾	792	793	792	792½
27	235¼	235½	233¾	234	71⅝	71¾	73⅛	73⅜	85⅛	85⅛	84⅛	84⅜	792½	793	792½	793
28	235½	236	233½	233¾	71¾	72	73½	73½	85¾	85⅞	84½	84¾	792¾	793	792½	793
31	236¾	237	234½	234½	72	72⅛	73½	73½	86¾	87	84¾	85	792	792½	792	792½
Av'g'e	£232.838		£231.463		£72.163		£73.133		£85.207		£83.972		£792.925		£791.913	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.9%, zinc 98% and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated. tons of 2,000 lb. unless otherwise noted. St—short ton; lt—long ton. (p) duty paid.

MISCELLANEOUS METALS

Aug. 31, 1959

Aluminum ingot, 99 plus % lb.		26.8¢
Antimony, spot, lb., less than carload, in cases		32.50¢
In bulk, carload lots, f.o.b. Laredo		29.00¢
Imported, 10 ton min. (p). 99½%		24¢
Bismuth, ton lots, lb.		$2.25
Cadmium, small lots, commercial sticks, delivered, lb.,...		$1.20
small lots		$1.30
Calcium, lb., ton lots, 98%, cast		$2.05
Chromium, 97% grade, lb., contract del.		$1.29
Cobalt, 97 to 99%, per lb. eff. Feb. 1, 1957		$1.75
Germanium, per gram, 10,000 gram lots	(d) 93¢ —(c)(d)35¢	
Indium, troy os.	$1 25 —	$2.25
Lithium, lb., 98%	$9 00 —	$11.00
Nickel, cathodes, lb. (a)		74¢
Other sales, reg. sellers		74¢
Sales by dealers, etc.		74¢
Magnesium, 99.8% carloads, lb. producer's plants, Velasco, Texas eff. Apr. 16		33¼¢
Palladium, troy os.	$18.00 —	$20.00
Platinum (wholesale lots), troy os.	$76 —	$80
Quicksilver flask of 76 lb. 25 flasks or more	$225 —	$228
Selenium, 99 plus %, lb.—(Feb. 19, 1958)		$7.00
Silicon, minimum 98%, carloads, lb.		19¢
Semi Conductor grade, lb.		$360
Tellurium, lb.		$2.50
Thallium, 100 lb. or more		$7.90
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb. (b)	$1.50 —	$1.60

(a) Eff. Dec. 6, 1956; incl. U. S. duty; (b) Eff. Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, (b) stu: spot		$31
term contracts		$31.50–33
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:		
44% Cr_2O_3 no ratio	$18 —	$19
48% Cr_2O_3 3 to 1 ratio	$38 —	$39½
Iron Ore, Lake Superior, Lower Lake ports, long ton:		
Old Range bessemer		$11.85(c)
Mesabi bessemer		$11.60(c)
Mesabi non bessemer		$11.45(c)
Lead (Galena), 80%, Joplin, Mo., ton		$156.12
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra. 87¢—90¢. Long-term contract nominal. Indian Gov't export duty discontinued Nov. 24, 1958.		
Molybdenum Ore, 90%, per lb. of Mo f.o.b. mines		$1.25
Columbium-Tantalum, per lb., combined oxides 10 to 1 ratio	$1.10 —	$1.20
Tungsten Ore, per stu of WO_3:		
Foreign 60%, c.i.f. U. S. ports, duty extra		$12.25–12.75
U. S. scheelite, f.o.b. mill	$20½ —	(a)$22
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines		31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton.		$64

(a) Nominal. (b) c.i.f. U. S. ports. (c) Eff. 1958 shipping season.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl. carload lots N. Y. docks		4–5¢
Cobalt Oxide, 72¼% to 73¼%, per lb. eff. Dec. 1, '56.	$1.33 —	$1.36
Copper Sulphate, 100 lb. eff. July 14, '59		$11.95
Germanium Dioxide, gm.		18½¢
Molybdic trioxide, technical, per lb. of Mo	$1.46 —	$1.47
Imported, incl. 37¢ duty	$1.75 —	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb. of Cr, (4-9% C)		28¾¢
Ferromanganese, 74 to 76%, per lb., shipg. pt.		12¾¢
Ferramolybdenum, 58 to 64% Mo lb. of Mo contained	$1.50 —	$1.82
Ferrosilicon, 50% per lb. of Si f.o.b. shipping point (3-1957)		14.60¢
Ferrotungsten, 72 to 82%, lb. of W contained		$2.15
Ferrovanadium, per lb. of V delivered	$3.20 —	$3.40
Silicomanganese, max. 1½% carbon, lb. contracts		12.8¢
Spiegeleisen, per long ton, 10 — 21% grade eff. Jan. 7		$102.50

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:		
Crude No. 1	$1,400 —	$1,810
Crude No. 2	$750 —	$1,185
Spinning fibers	$370 —	$600
Shingle fibers	$180 —	$220
Paper stock	$120 —	$145
Waste	$75 —	$86
Shorts	$40 —	$75
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):		
Crude No. 1		$1,522
Spinning fibers	$220 —	$787
Asbestos, Vermont, f.o.b. Morrisville:		
Spinning fibers	$370 —	$428
Shingle stock	$181 —	$200
Paper stock	$120 —	$152
Waste, stucco or plaster		$86
Refuse or Shorts	$41 —	$75
Barytes f.o.b. cars:		
Georgia, crude, per ton		$18
Missouri, 94%, $BaSO_4$, per short ton	$16 —	$18
Crude oil well grade, min. 4.3% sp. gravity, st (a)		$15
Imported, c.i.f. Gulf Ports, st	$16 —	$18
Bauxite, long ton, f.o.b. point of shipment:		
Domestic, crude, 50 to 52% (not dried)	(c)$ 5.00 —	$5.50
Domestic, chemical, 55 to 58%	(c)$ 8.00 —	$8.50
Domestic, abrasive, 80 to 84%	(c)$18.00 —	$18.50
Imported metallurgical, per lt. f.o.b. Br. Guiana, dep. on grade		$7.14
Feldspar, bulk ton:		
Potash or soda feldspar, 200 mesh, ceramic grade		$20.50–$21
Glass feldspar, white, 20 mesh		$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 —	$41
60% effective CaF_2	$33 —	$36.50
Acid 97% concentrate, bulk, ton (eff. 12-1-56)		$50.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 —	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington		$46

Mica—Domestic, f.o.b. mines. Punch 7¢ — 12¢ per lb. according to size and quality. Sheet clear 1½ x 2-inch, 70¢ — $1.10; 2 x 2 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 — $2.10; 3 x 3-inch, $1.80 — $2.30; 3 x 4-inch, $2.00 — $2.60; 3 x 5-inch, $2.60 — $3.00; 4 x 6-inch, $2.75 — $4.00; 6 x 8-inch, $4.00 — $8.00. Wet ground, very fine, $140 — $155 per ton, Bulk sales, dry ground; $30 — $55 per ton. Scrap $20 —$30.

Ocher, Georgia, ton in sacks	$26.50 —	$32.00
Pyrites, Spanish, per long ton unit of S. c.i.f. atlantic ports		Not quoted
Sulphur, per lt. f.o.b. U. S. mines: bright		$23.50
dark		$22.50
Mexican, for use in Mexico, per metric ton, f.o.b. mines, 280 to 395 pesos, depending on use	$22.40 —	$31.60
For export f.o.b. vessel, lt. dep. on grade	$22 —	$24
Talc, f.o.b. works, ton:		
New York, purified	$18.00 —	$20.00
Vermont, extra fine		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

(a) Some restricted sales at $11.50, (b) Corrected. (c) Nominal.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$80.00
Structural shapes, Pa., Ala., etc. 100 lb.	$5.30 —	$5.50

Save money when replacing pit tractors...

switch to fast, rubber-tired tractors . . . handle twice the work at half the cost!

When modernizing your pit operations, don't overlook the savings you can make by replacing 2 or more slow-moving track-type tractors with a fast, *rubber-tired* tractor, to handle your scattered pit and road clean-up.

Check these important savings you can make with a modern, high-speed, 218-hp LeTourneau-Westinghouse Tournatractor®:

1. Between pit chores, rubber-tired tractor can handle haul-road maintenance and drainage problems . . . to keep your production units rolling *fast* and *safely*.

2. Mobile, 17.2-mph Tournatractor quickly drives to new areas of operation . . . spends its time working instead of crawling.

3. It cleans up around plant area, dresses and maintains stockpiles.

4. Tournatractor spots rail-cars, tows equipment — reduces costly time waiting for switch engines.

5. If winter snow is a problem, LW tractor with V-type snow plow, or with dozer blade, clears roads, loading and dumping areas — keeps pit operations open and safe in all kinds of weather.

Every tractor assignment — anywhere on your property — can be handled quickly and efficiently by versatile Tournatractor. And, if your pit normally sidelines equipment during its off-season, this mobile LW tractor can be rented out to nearby contractors, counties, or municipalities. It's easy to keep Tournatractor busy all year long!

Try it in your pit

Let us demonstrate a LeTourneau-Westinghouse Tournatractor in your pit. Write or phone for complete information. No obligation.

CT-2138-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

—— Make a "spec check"...

Compare Haulpak... see how

LW engineers "threw away the book" when they designed the new Haulpak off-road hauler... for *your* benefit. Some of the exclusive features that resulted are shown here. They are advantages that help you move *more* tonnage, *faster*, at *lower* net cost per ton.

To see what this advanced design approach means to Haulpak, check its specifications. You'll want "spec sheets" in your files anyway, and your LW Distributor can supply you copies. Then, with basic Haulpak facts handy, compare them to *other* off-road haulers.

WHAT YOU WILL FIND WHEN YOU COMPARE HAULPAK:

(Competitive hauler specifications are "averaged out" for simplicity purposes... but Haulpak superiority is just as clear over any single machine.)

WHAT TO COMPARE	Off-road Haulers 20-30-ton class		Off-road Haulers 30-40-ton class		HOW YOU BENEFIT
	Average*	Haulpak LW 27	Average*	Haulpak LW 32	
Length Wheelbase Turn Diameter	26'7" 14'4" 64'3"	23'10" 10'10" 44' 6"	31'5" 16'7" 77'6"	23'10" 10'10" 44' 6"	*HAULPAK is shorter.* You maneuver faster, quicker and in less space.
Top Speed (in mph)	30.7	35.4	25.2	38.8	*HAULPAK is faster,* for more cycles per hour, more tonnage per shift.
Empty Weight (in lb)	49,300	43,020	73,400	44,950	*HAULPAK is lighter,* for more payload weight, less "dead" weight.
Ground Clearance Front Axle Rear Axle	 16" 16"	 25" 20"	 17¼" 18½"	 25" 20"	*HAULPAK has higher clearance,* to minimize troublesome "dozing" action.
Brake Surface (sq inches)	1511	4680	1834	5148	*HAULPAK has bigger brakes,* for greater safety, more steady use of high speeds.

and here are some of the design features that make these HAULPAK advantages possible

(*Based on specifications available at time of printing)

All new . . . but Haulpak is already a fully-proven piece of equipment. Units worked for over 14 months on construction jobs, in mines, and in quarries, before the first Haulpak was put on the market. Exceptional results of these tests are now being duplicated all around the nation.

it can cut your haul costs

Hydrair* suspension...eliminates springs...permits higher clearance, shorter turns

Haulpak rides on air! 4 Hydrair units replace leaf springs. System cushions against loading and travel shock, reduces maintenance costs. Eliminates front axle, and compensates for off-center load. *COMPARE IT!*

"V"-shaped body...lets Haulpak outcarry trucks that are longer, higher, heavier

Bonus yardage in every Haulpak load rides in exclusive V-bottom of body. Slope also helps fill all corners for low-void payloads. "V" lowers center of gravity for better stability, traction, on grades. *COMPARE IT!*

Box-beam frame...3 times stronger, ⅓ lighter, carries 30% more payload weight

Strongest hauler body ever built. Floor and all wear-surfaces made of 10,000 psi steel, yet weighs 33% less than comparable bodies. Body is exhaust-heated. Haulpak hauls 30% more than its own total weight. *COMPARE IT!*

Available in 22, 27, and 32-ton capacities

PLUS: MINIMUM MAINTENANCE (entire lube-check, needed only at 500-hr intervals, consists of just 3 easy-to-reach grease fittings)... POWER-TRANSFER DIFFERENTIAL (famed Tournapull® feature which automatically transfers power to wheel on best footing when going is rough)... POWER-MISER FAN (cools with 20 to 25 less hp drain)... 100% RUBBER-MOUNTED BODY (absorbs impact and shock of loading)... FOUR SEPARATE BRAKING SYSTEMS (for fast stops with complete safety)... POSITIVE POWER STEER (for faster turning, easier handling)... SIMPLE SIX-GEAR FINAL DRIVE (compared to 12 or more usually standard)... BIG, ROOMY CAB (has many work-efficiency features).

*Trademark HP-2193-DC-2

LW

Where quality is a habit

LETOURNEAU-WESTINGHOUSE COMPANY
PEORIA, ILLINOIS
A Subsidiary of Westinghouse Air Brake Company

Paired Up FOR PERFORMANCE

When it comes to pipe lines in mining service, you can't beat the combination of NAYLOR pipe and Wedgelock couplings.

The light weight of the pipe makes it easy to handle and install. The spiral-lockseam provides strength and safety for uninterrupted service . . . whether the pipe is strung on the surface, supported on bents or suspended.

With the Wedgelock coupling, you have the fastest, most economical method of pipe connection. A hammer is the only tool required to connect or disconnect it.

For handling water, tailings or air, it will pay you to check into this practical NAYLOR combination.

Bulletin No. 59 tells the story. Write for your copy today.

NAYLOR PIPE *Company*

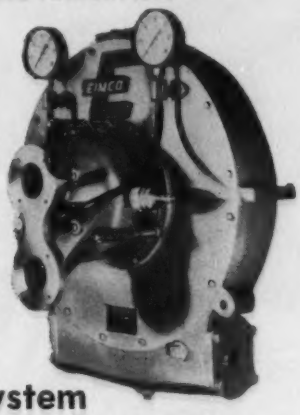
1243 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

These Twin Features Give You Better Drum Filter Performance . . .

1 HY-FLOW Valve

. . . eliminates vacuum loss

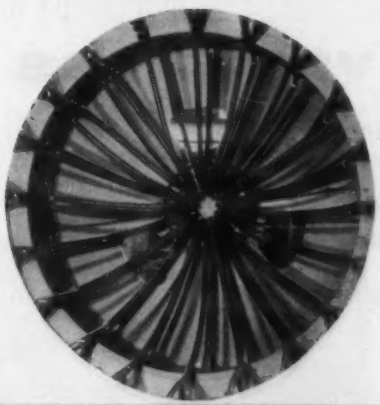


Filtrate flow is always unrestricted with Hy-Flow filter valve, developed by Eimco. This new, streamlined valve entirely eliminates all angular passages which caused troublesome turbulence and vacuum loss on flat type filter valves.

With Hy-Flow valve, drum filters operate more efficiently throughout all zones of the filtration cycle. Operators report greatly improved operating economies.

2 E-VAC System

. . . eliminates moisture in piping



Another major improvement in drum filter design, perfected by Eimco, is the E-Vac system of sweeping moisture from piping with air.

Vacuum to lead and trail pipes from each drum compartment is alternately blocked off as drum revolves. Air drawn through pipes sweeps moisture from piping system and drainage deck. No blow-back of filtrate. Result is a dryer filter cake.

The Eimco representative in your area can give you more facts on Eimco's complete line of filtration or process equipment for liquid-solids separation.

THE EIMCO CORPORATION • SALT LAKE CITY, UTAH

Research and Development Division, Palatine, Illinois • Process Engineers, Inc. Division, San Mateo, California

Expert Offices Eimco Building, 51 - 52 South Street, New York 5, N. Y.

BRANCHES AND DEALERS IN PRINCIPAL CITIES THROUGHOUT THE WORLD B - 423

ROLL SEVEN — EVERY PASS

Sevens pay off on the Iron Range, too, especially when made by a Marion 151-M.

This 7-yard machine continues to strengthen its reputation for steady, low-cost, dependable loading.

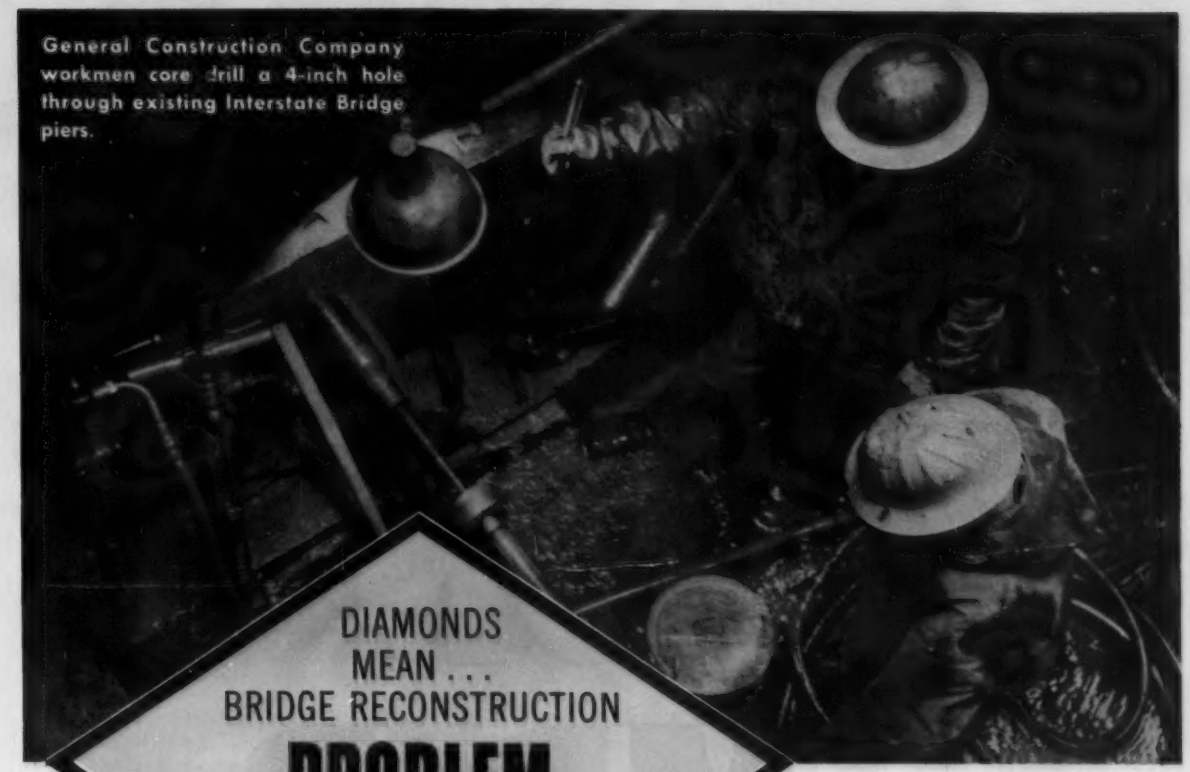
Here is stamina for the heaviest, hardest digging, with smooth, fast cycle time. Here is Ward-Leonard electric control with refinements that save on power costs and protect the machinery against shock and overload.

Let Marion mining specialists tell you about the work records being made in mining by the 151-M, and outline what it can do for you.

You get **MORE** *with* **MARION**

MARION POWER SHOVEL COMPANY • Marion, Ohio

A Division of Universal Marion Corporation



General Construction Company workmen core drill a 4-inch hole through existing Interstate Bridge piers.

DIAMONDS MEAN . . .
BRIDGE RECONSTRUCTION
PROBLEM SOLVED!

Christensen Custom Designed Diamond Equipment Aids in Interstate Bridge Reconstruction

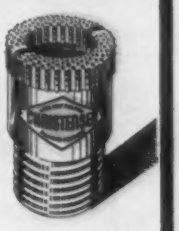
Raising the Interstate Bridge between Portland, Oregon and Vancouver, Washington is a mammoth job that demands specialized equipment. The reconstruction of the Interstate Bridge is under the supervision of the Oregon State Highway Department, A. A. Rear, Resident Engineer. Aimed at providing additional vertical clearance for Columbia River traffic, five concrete piers are being heightened as much as 38 feet, requiring enlargement of their bases with new concrete. To tie the new concrete to the old, 45 holes were core drilled. These holes were 14 feet long and four inches in diameter to allow insertion of heavy steel rods. These tensioned rods, projecting six feet from each end of the holes, assure proper adherence of the new concrete to the existing bases. The special bit and core barrel necessary for this job were designed and manufactured by Christensen under the supervision of T. R. Harris, General Superintendent, General Construction Company of Portland. This unique equipment was specifically designed to operate economically in a confined space 40 feet below the river surface. Maximum efficiency and complete customer satisfaction were achieved.

If you have a unique operation or a particularly difficult drilling problem that requires specialized equipment, consult Christensen about diamond drilling equipment manufactured to your requirements.

Diamonds Mean, "Less cost per foot."

CHRISTENSEN DIAMOND PRODUCTS

1937 SOUTH SECOND WEST • SALT LAKE CITY, UTAH



Giant capacity with typical Mack performance advantages

NEW MACK 40-TON DUMPER

Mack's new LYSW Model is engineered and built to handle 40-ton loads of ore and rock with greatest performance and at lowest cost. Whether in strip mine or quarry service, this rugged addition to the Mack line brings traditional Mack performance to the most formidable hauling jobs. Operators net more tons per dollar because no other truck can match Mack's long operating prime of life under the most demanding conditions.

Powered by a 450 hp Cummins diesel engine, this 4-wheel-drive, 6-wheel end-dumper, with its 8-speed overgear transmission, air assist clutch, or optional torque-converter drive, has the ability to easily haul the biggest loads and at the same time provide unequalled handling ease and safety.

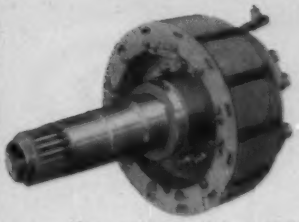
Mack quality shows up on the LYSW wherever you look. Axles and axle housings made by Mack are unmatched for sheer strength and durability. Mack-built transmissions are noted for dependable performance and long life because of their drop-forged, case-hardened gears and oversized shafts and bearings. Even the cab, with its heavy-duty all-steel welded construction bears the unmistakable stamp of Mack quality – as does the exclusive design of the driver's seat, unquestionably the finest offered for the man behind the wheel.

Let your Mack branch or distributor explain the many new and unique advantages of the LYSW Model. When you get the facts, you'll be convinced that an investment in a Mack makes sense from the start. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd., Toronto, Ont.

7140

MACK
FIRST NAME FOR
TRUCKS

In grueling, long experience on the Mesabi Range, the new LYSW 40-tonner has responded easily to every demand made upon it... **SO MUCH SO, THAT THE DEMAND BY THE INDUSTRY FOR THE MACK LYSW HAS EXCEEDED ALL FORECASTS.**

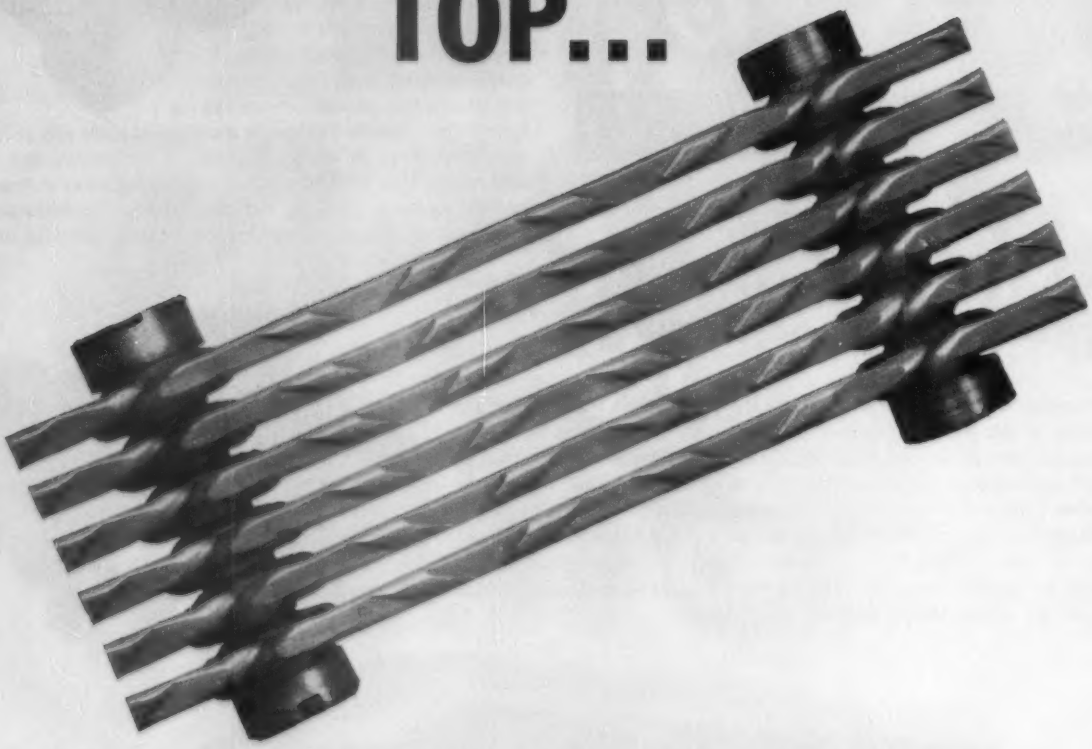


New radial-type maximum contact brakes are of latest air-over-hydraulic aircraft-type design. Positive braking control regardless of load is provided by use of 12 equally spaced blocks on each brake, activated by simple, positive, self-equalizing air-hydraulic system. The air-hydraulic rotochambers for each wheel are mounted inside frame for complete and safe protection. A set of internal expanding air brakes on the front wheels and a powerful hand brake working against the drive shaft complete the LYSW's braking system.

New alloy-steel frame on the LYSW Model is **stress relieved.** This assures a minimum of localized stress concentration with an extra wide margin of safety. The frame is built with tremendous strength and endurance factors which enable it to handle the heaviest loads and, at the same time, shrug off shock and vibration. I-beam side rails of heat-treated alloy steel have exceptional strength and stiffness (section modulus of 138), and the massive X-construction over the bogie ensures freedom from bending, wracking and twisting.

Newly designed Mack Balanced Bogie on the LYSW offers the strength and simplicity of straight-through drive and single-reduction carriers with Mack Planidrive reduction in the hubs. Exceptionally long tire life is achieved through unusual bogie flexibility which also reduces twisting and wracking of the frame. Even with diagonally opposite wheels raised more than a foot each, this flexibility keeps all wheels equally loaded and the frame level as shown. Mack's exclusive walking-beam suspension results in longer spring life by relieving springs of shock loads. And Mack's exclusive Power Divider directs power to the wheels having traction.

HENDRICK RIFFLE TOP...



TOPS IN THE TRADE

for excellent dewatering efficiency and minimum abrasion. EXCLUSIVE Riffle Markings on Hendrick Wedge Wire Screen guide fluids toward the opening for greater draining capacity. The Riffle also lifts oversized particles above the screen's opening level . . . reduces wear caused by abrasion. And, it helps prevent caking.

For details on how Hendrick Riffle Top Screen combines the best of flat-top and cone wedge wire screens, write Hendrick today.

HENDRICK

MANUFACTURING COMPANY

70 DUNDAFF STREET, CARBONDALE, PA.

PERFORATED METAL • PERFORATED METAL SCREENS • WEDGE-SLOT SCREENS • HENDRICK WEDGE WIRE SCREENS • ARCHITECTURAL GRILLES • MITCO OPEN STEEL FLOORING–SHUR-SITE TREADS • ARMORGRIDS • HYDRO DEHAZERS • DISTILLATION COLUMN INTERNALS

This Cat No. 12 Motor Grader works 16 hours a day, 6 days a week, all year round for the Tecumseh Coal Corp., Boonville, Indiana. Its many jobs vary from cleaning up coal to grading haul roads.

LOOK! THESE IMPROVEMENTS IN THE No. 12 PAY OFF IN EVEN HIGHER PRODUCTION!

Increased throat clearance — New blade, lift and circle — One-piece case for transmission and final drive — New, two-tooth power control clutches — New, positive mechanical lock

SINCE it was introduced twenty-one years ago, the Caterpillar No. 12 Motor Grader has earned the title "standard of the industry." Constant improvements have kept it the undisputed leader in its class. Here are the latest improvements that enable you to get even more work at lower cost with less maintenance from this high-production machine:

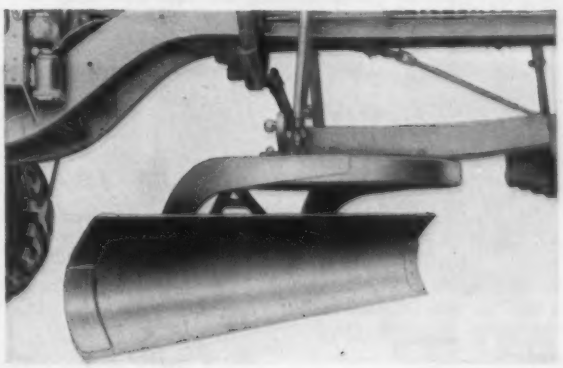
1 Clearance between the top edge of the blade and bottom edge of the circle has been increased to 5 INCHES. This provides improved rolling action, allows more material to move across the blade for greater production.

2 Blade thickness has been increased to $\frac{7}{8}$ inch and blade beams have been increased in length and thickness to handle heavier loads. Lift arms have been lengthened and links shortened to enable operator to obtain all blade angles more easily. Circle reverse gear housing has been redesigned for better clearance as well as to increase the life of components and make service adjustments easier.

3 There's a new, stronger one-piece case for the transmission and final drive. This eliminates possible leakage at gaskets. In addition, transmission bearings have been strengthened for longer gear life.

4 New mechanical controls for reduced kickback, easier engagement. New power control clutches have two teeth, instead of four, and improved contact angles. They are more positive to engage, easier to hold in position.

5 New blade controls feature a positive mechanical lock—exclusive with Caterpillar. When the control is in neutral, the power shaft is locked by a set of gear teeth to prevent creeping.



See the improved No. 12 at your Caterpillar Dealer. Whatever the job, he has the right capacity motor grader for it. Besides the 115 HP No. 12, there's the big new 150 HP No. 14 and 75 HP No. 112. Ask for a demonstration!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

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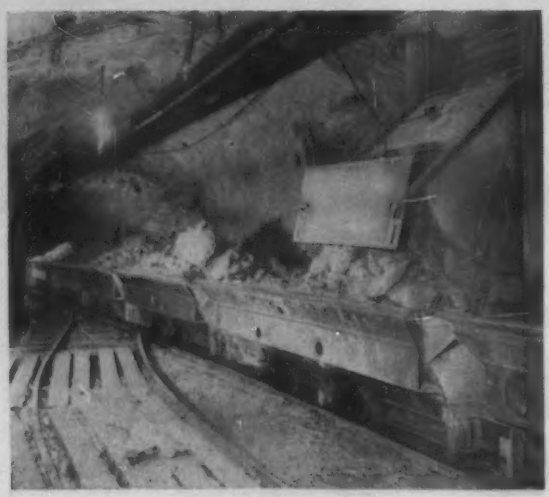
STEP UP PRODUCTION WITH THE IMPROVED No. 12

This is the most economical

Haulage cost, including maintenance on these S-D Automatic Bottom Dumping Cars, the locomotive plus labor for haulage, is less than 5¢ a ton!



1. There haven't been any door damages to these cars . . . nor any derailments due to door mechanism failure. We design to take the service. We know of many derailments of other type cars due to high center of gravity, dumping members sticking out on the side of cars, etc. We invite you to ask those who have experienced the dependability and economy of our S-D Automatic Bottom Dumping Cars.

BUT, you might ask, *how it is possible for bottom dumping mine cars to take such punishment?*

Can the hinge and latch mechanisms take the impact of shock loading?

It doesn't appear bottom dumping cars could have continuity through the center. Then, isn't the drawbar and buffing of the loads taken from the coupler out to the sides, through the sides and around them?

Do the latch mechanisms and hinges, no doubt foolproof in coal or potash service, become hopelessly clogged when running through wet muck which contains clay, leached ore, etc.?

The answer to all these questions is that S-D Automatic Bottom Dumping Mine Cars can be designed to meet any, all and every requirement.

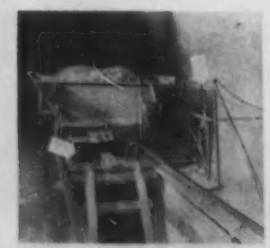
Let's take those pictured on this page in operation in a hard rock mine, and give you the specific reasons in answer to your well put questions. Then mention the general advantages of bottom dumping cars, such as automatic dumping without labor, which provide the most economical way to haul rock and ore.

This car was designed more along the lines of coal cars. No special consideration was given for severe loading conditions. The mine that purchased them had previously experienced 15 years of hard rock service with similar S-D Automatics, also designed for coal service.

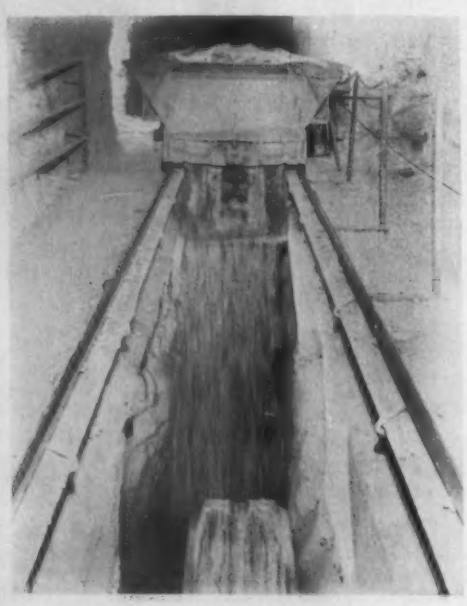
After five years service, they are averaging 8¼ tons of hard rock and making more than 12 turnovers per shift. One man, his locomotive and 10-cars-only in a trip frequently load from three different chutes and dump 125 cars in a shift.

As we have reported, their haulage cost, including maintenance on both cars and locomotive plus labor for haulage, is less than 5¢ a ton.

2. Note the Twin Unlocking Devices prior to being raised remotely by operator from his locomotive.



3. The Twin Safety Latches on S-D Automatics must be operated independently but simultaneously to open doors. Only mechanism that can achieve this is the Twin Unlocking Devices mounted between rails at the dump.



4. Here is an action picture, showing first car in trip of 10-cars dumping on-the-move. Part of the Automatic Door Re-Locking Mechanism may be seen in lower part of picture.

5. This is a difficult picture to obtain, but you may see image of door during the Automatic Re-Locking action as trip continues its non-stop dumping and return for re-loading.

way to haul hard rock and ore

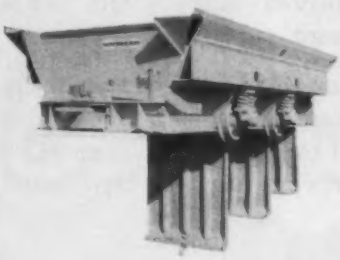
A few of the latches have been broken and a few of the trunnions have been bent during those five years. On repeat orders for cars to operate under similar service conditions, we are using T-1 Steel in the trunnions as well as a fabricated steel latch, which eliminate these minor, in-frequent repairs.

Note that the car is otherwise designed for shock loading, having spring mountings. We have also furnished rubber mountings.

The S-D Automatic's Twin Jerk-Out mechanism is located well above the rail. As far as wetness of muck, the service has been severe, but no difficulty has been experienced.

You may see in inset picture at right this S-D Automatic prior to shipment. You have here a photographic comparison of the car prior to installation, then after five years service.

We can prove by mathematics, and can back mathematics with more than 40 years experience in building bottom dumping mine cars, that our car structure, as far as side sills, bumper construction, etc., is designed to take drawbar pull and buff of heavy trains. In fact, this construction is many times stronger than such items as tail bolt or standard link or pin.



You will be interested in the S-D Automatic pictured below. Here is one of our designs for extremely heavy duty. Further it was developed to solve particular handling problems.

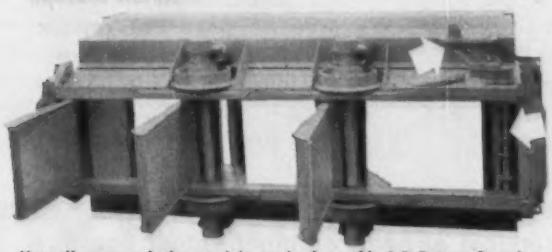
The material this customer handles is very sticky and will not shed well. They had tried all types of cars, including side dump, rocker, gable, etc. They felt they had a better chance of getting the muck out of our S-D Automatic Bottom Dumping Car. Their judgment has proved correct.

These S-D Automatics were designed with all flares on 60 degrees. Too, false bottom doors were furnished to also aid in clean shedding.

They also wanted the largest possible car in drift driving. This would cut down on car change. The S-D Automatic enabled them to obtain the greatest capacity for overall dimensions that could be let down the shaft without dismantling.

Automatic couplers were shipped separately for mounting underground.

The cars were equipped with 18" wheels with spring mounted trucks.



Note (by arrows) the special cam latch on this S-D Bottom Dumping Car and full width door support. This car was designed specifically for handling iron ore, plus it enabled the customer to obtain more capacity within their dimension limitations than any other type car they could buy!

Note special cam latch at rear end for full width door support.

What we are discussing here is an S-D Automatic specifically designed for hauling iron ore and tailor-made to a customer's requirements. Some of the major specs on the car you may like to know are: 36" Track Gauge . . . 46" Wheel Base . . . 15' 6" long . . . Shipping Weight 9,440 lb.

Only bottom dumping mine cars effectively provide automatic, no labor, dumping. Only bottom dumping mine cars provide for such simple, low cost dumping facility. Too, S-D Automatics enable you to use large ore pass as surge bin to keep continuous supply of material for uninterrupted operation of mill . . . keeps mill and mining operations separate for efficient operation of each.

We believe the two requirements to obtain the most economical haulage system are (1) Minimum capital investment in haulage system, and (2) Minimum direct operating costs.

The reasons why S-D Automatics best meet these two requirements are:

MINIMUM CAPITAL INVESTMENT—

a. More tons per car per shift hauled (fastest car turnover) which means LESS CARS needed!

b. Maximum loading speeds (see inset picture at right showing how cars pictured on page at left are loaded by locomotive operator himself. Note the remote controls. They can operate locomotive remotely, or S-D Hydraulic Car Spotter or S-D "Brownie" Hoist, and open and close the chute).

c. Maximum dumping speed (automatic non-stop without labor)

d. Maximum surge bin capacity (no loaded cars waiting at dump)

MINIMUM DIRECT OPERATING COST—

a. Automatic controlled loading

b. Fewer cars and fewer locomotives

c. Automatic Dumping (no men required)

We hope we have pointed out here by actual case experiences answers to questions you have had . . . that you are satisfied immediate consideration should be given to these S-D Automatics . . . that you want to get in touch with us to discuss the matter in detail. Every haulage situation is an individual problem, and it is your situation we both are interested in at this moment. May we hear from you? *Sanford-Day Iron Works, Inc., P. O. Box 1511... Telephone 3-4191, Knoxville, Tennessee*

SANFORD-DAY

KNOXVILLE, TENNESSEE

MINE CARS—all types . . . S-D Brakeman Cars . . . S-D Man Cars . . . S-D Hydraulic Car Spotters and S-D "Brownie" Hoists . . . S-D Automatic Loading Stations for mine and railroad cars . . . S-D "Floater" Wheels . . . S-D Mine Sheaves and Rollers . . . S-D exclusive Hard-Facing Process that puts old wheels back in operation for years of additional service.

THE BETTER WAY

The P&H way—"the better way" of design and construction puts P&H Electric Shovels in a class by themselves—they alone are not essentially the same as the shovels of a generation ago.

P&H has always been the pioneer developer of dramatic new designs and processes—this is why P&H Electric Shovels incorporate design fundamentals which make them different from all others. By their pioneering, P&H found "the better way" to production premiums as high as 10%, lower unit cost and more net profit for P&H owners.

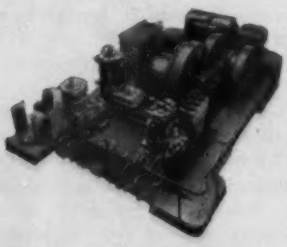
Some exclusive P&H design fundamentals not found in other electric shovels are:

1. ELECTRONIC CONTROL

This patented P&H control accomplishes the quickest work motion reaction time known for electric shovels. Control maintenance expense is reduced as much as 80% by elimination of all moving parts for a completely closed circuit system.

2. MAGNETORQUE® HOIST DRIVE

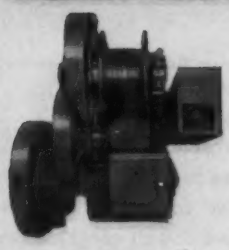
This patented hoist drive electro-magnetically transmits the full digging power of an A.C. motor direct to the dipper without motor generator set conversion to D.C. current! It gives up to 30% higher bail pull for more uniform digging speed and greater dipper fill factor.

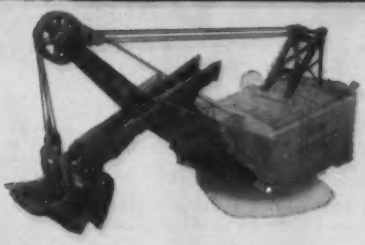


3. FULL WELDED STEEL CONSTRUCTION

P&H was the originator of electric shovel construction by the unit welded rolled steel method. Their accumulated wealth of experience pays P&H owner dividends in the form of exceptional long shovel life in hard digging—accomplished by full welded steel construction.

"P&H is now the world's largest builder of full-electric and diesel-electric shovels. Only P&H manufactures their own electrical as well as mechanical components—designed specifically for electric shovel service—gives you the service assurance of single source responsibility."





4. ENCLOSED HOIST MACHINERY

Only on the P&H Shovel is all deck machinery—the power trains for hoist, swing and propel drives—enclosed in oil tight gear cases. No open gearings! Modern power train design at its best!

5. INDEPENDENT CRAWLER PROPEL MOTOR

Only P&H Electric Shovels have an independently motored crawler propel drive. P&H gives shovel owners the advantages of independent motoring—the basic principle of electric shovel design and purpose. The P&H is FULL-ELECTRIC in every work motion.

6. T-1 STEEL ... SHOVEL ATTACHMENT

Only P&H furnishes as standard a boom and dipper handle fabricated of ultra high strength T-1 steel for high impact absorption ability, especially important in sub-zero temperatures. P&H pioneered and is the most extensive user of rolled alloy steels.

P&H MINING EXCAVATORS

OUR 75TH YEAR

HARNISCHFEGER CORPORATION • Construction & Mining Division • Milwaukee 46, Wisconsin

P&H LINE

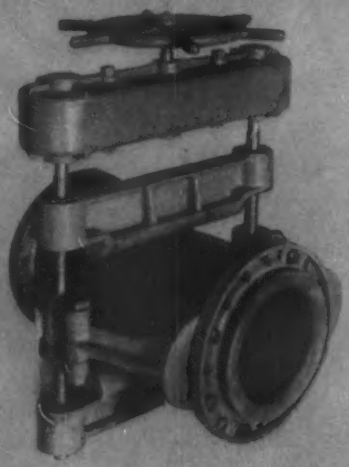
Full-Electric and Diesel-Electric Shovels & Draglines: 3½ through 10 yds.

Diesel Excavators: ½ through 3½ yds.

Truck Cranes: 10 through 80 tons

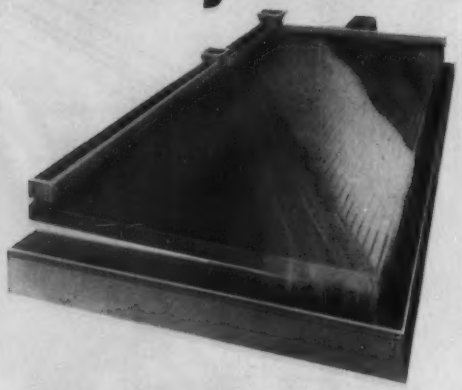
Massco-Grigsby Pinch Valves

for abrasive and corrosive pulps and liquids



- Rubber and neoprene sleeves
- Patented "hinged" sleeve. Recesses serve as "hinges" during compression; reduce strain and permit tight closing.
- Unobstructed flow eliminates high friction loss.
- Split flanges and patented Flex Seal ends assure perfect seal.
- 1" to 14" inside diameter.
- Pressures to 150 psi.
- Temperatures to 200° F.
- Cannot leak or stick.
- No working parts in contact with pulp or liquid; no packing glands.
- Remote control available.
- Can be equipped for automatic regulation.
- Closing mechanism... manual handwheel; handwheel with chain and sprocket reduction unit; electric worm gear motor reducer; chain operated torque arm reducer; hydraulic; air-hydraulic.

Wilfley Concentrating Table



many profitable applications in modern metallurgy

the genuine WILFLEY TABLE, as manufactured by Mine & Smelter, has been an important factor in the success of many metallurgical processes for years. There are still many applications where the Wilfley Table is of particular value and cannot be equalled for conomical and efficient performance. Some of these are . . .

- Before or after flotation for recovery of mineral not readily recovered by flotation.
- As pilot tables following flotation to indicate efficiency of flotation.
- To concentrate low grade mineral producing a high grade concentrate for further treatment.
- To wash and clean inferior coals, iron ore, etc.
- In metal and reclamation plants.
- For two or more mineral separations from flotation concentrates, previous table concentration or from original table feed.

The Wilfley Table has an easily adjustable stroke from 5/8" to 1", a speed range from 240 to 300 strokes per minute, an adjustable table inclination from zero to 1" per foot, and a selection of wood riffles of various depth and taper . . . all of which permit a flexibility to best meet the conditions of each application.

Wilfley Tables are available in two commercial sizes and two laboratory sizes. Drives available include: flat belt, constant speed V-belt, variable speed V-belt, variable speed motor drive. The tables may be equipped with steel channel understructure, or with base for mounting on concrete piers.

Manufacturing Division

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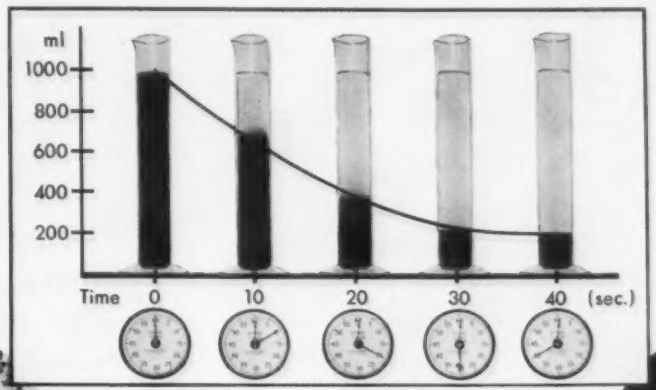
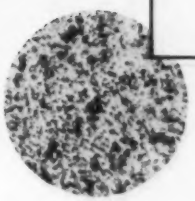


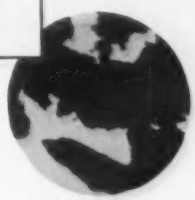


Before flocculating

see how fast solids settle with new

SUPERFLOC* 16

FLOCCULANT



After adding SUPERFLOC 16

Plant tests prove SUPERFLOC 16 outperforms previous flocculants for solid-liquid separations

IN COAL PREPARATION

As little as 1 lb. per hour drip fed as a ½% solution can treat up to 10,000 gallons of wash water per minute. Agglomerating wash-water fines into large, fast settling flocs, SUPERFLOC 16 increases thickener or settling pond capacity, minimizes stream pollution, assures clear effluent or recycle water, frequently pays for itself in additional fine-coal recovery.

IN URANIUM OPERATIONS

Incredibly small amounts fed to the leach pulp improves settling and filtration rates; assures clearer thickener overflow. SUPERFLOC 16 reduces soluble loss in thickened solids or filter cake, prevents sand slime separation in the thickener, gives higher pulp density in the thickener underflow.

WRITE FOR THIS FREE BULLETIN

Write for technical bulletin describing SUPERFLOC 16 and AEROFLOC® Reagents, working sample and full instructions for conducting your own plant test.

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EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

CYANAMID INTERNATIONAL — *Mining Chemicals Department*
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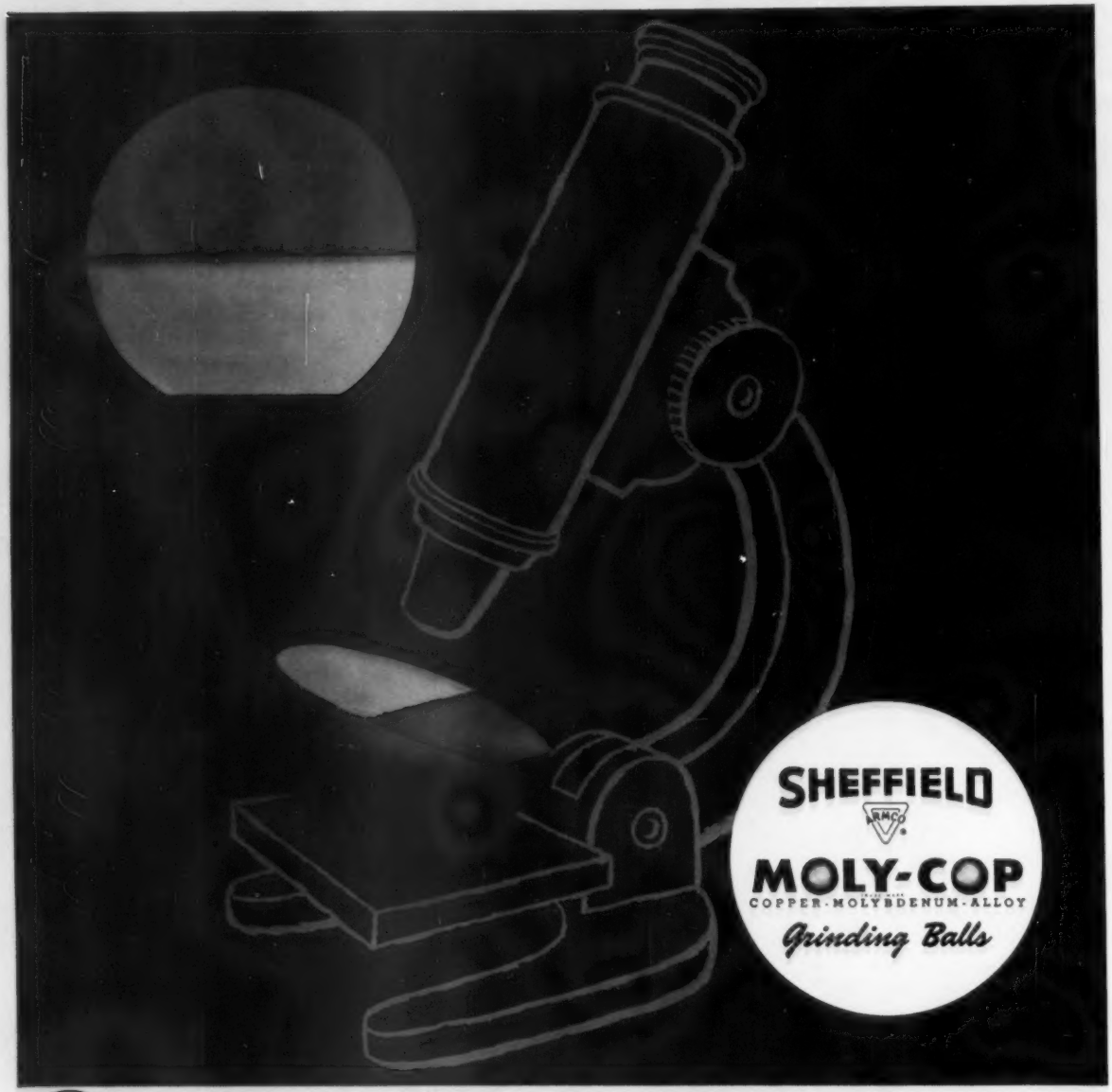
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.



The Standard of Comparison for FINE GRAIN STRUCTURE

You can see, even without magnification, the finer, denser grain structure of Sheffield Moly-Cop balls. The uniformity, hardness and toughness of this grain structure extend to the very core of the ball. It's the standard of comparison in grinding ball performance tests. And a big reason why you'll get longer service, less down-time, and other important production economies with Sheffield Moly-Cop Grinding Balls.

New steels are born at Armco

SHEFFIELD DIVISION

ARMCO STEEL CORPORATION

OTHER DIVISIONS AND SUBSIDIARIES: Armco Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

NEW PRODUCTS DIGEST

In this issue—a bit and steel leasing plan for lower cost mining, Bucyrus-Erie acquires the rights to the Kolbe bucket wheeler—an earth moving monster with ten 2.5 cubic yd buckets—a conveyor belting repair kit, a high-powered bowl scraper, a baghouse using glass filters, a large agitator, an automatic Eimco-Burwell and many other interesting new product and literature notices.

BITS are color coded to indicate size after being resharpened. Batches of new bits are tested in local mine stopes.

BROKEN bits are replaced, good ones resharpened and returned on a weekly schedule. Steel is reforged and heat treated.

Hard Metals Ltd. Runs Incentive Bit and Steel Leasing Plan For Algoma Basin Mines (1)

IN FEBRUARY 1958, a contract drilling system of providing bits and steel for use on a leasing basis was introduced to the Canadian uranium mines in the Algoma Basin, Elliot Lake, Ontario by Hard Metals (Canada) Ltd.

It was a first for such a comprehensive program in Canada. Its appeal to mine operators is readily apparent—at first there were but three mines using the program—within six months, there were ten. Here are some of the details about the contracting program obtained on a recent trip to Elliot Lake.

These advantages are available to the mine operator:

The mine does not have to warehouse bits or steel.

With reasonable care of the suppliers' equipment, the mine gets a fixed maximum cost per ft drilled and a reduced cost per ft drilled for bit and steel performance in excess of a predetermined basic footage.

The mine no longer needs a steel shop for reconditioning broken or damaged bits or steel.

Responsibility for maintaining an adequate inventory rests on the supplier, not on the mine.

The supplier, Hard Metals, does research and development of new bit and steel designs and construction right in the area to develop equipment best suited to the ground in the area.

A resharpening service is available for bits which eliminates the need for the mines to have their own shop. All but two of the mines at Elliot Lake use this service which is an extra cost in addition to the lease cost.

In 1958, after considerable testing of carbide grades and bit designs, the Elliot Lake contracts were offered at a base rate of 130 ft per bit; footage drilled in excess of 130 ft to be paid for at one-half the contract rate. The average bit performance is taken by dividing the footage reported weekly by the mine by the number of new bits issued in the same period—the better the performance, the less the mine pays per ft and the larger the total revenue received by Hard Metals. The contract offers an incentive to the mine operator to get the most out of his equipment and men, and to Hard Metals to provide the best possible equipment for this particular locality.

EACH BIT is coded to tell when the bit was made. Each week, each mine reports footage drilled from which Hard Metals determines the average footage and cost.

The price per ft includes the steel cost—a flat rate incentive being paid on steel performance in excess of 300 ft/steel. Downward adjustments in the base cost per ft are made every six months in cases where the average performance for the previous contract exceeds the basic performance by 10%. In the event a mine achieves less than the basic performance per bit, the cost per ft remains at the fixed base rate, but the mine is liable to a penalty on lost or damaged equipment to bring the revenue to Hard Metals up to the equivalent of 130 ft per bit.

Details presented here were obtained from Hard Metals' managing director, James Nichols, and his office manager, Donald Fraser.

The mines like the arrangement. As a result of the incentive clauses contained in the contracts, performance per bit has been greatly improved at some mines. Due to greater care and control at the mines and continued improved quality both in manufacturing and reconditioning by the supplier, performance has improved from the starting base rate of 130 ft per bit to as much as 200 ft in some mines. Steel performances have risen to as high as 600 ft from the starting 300-ft base.

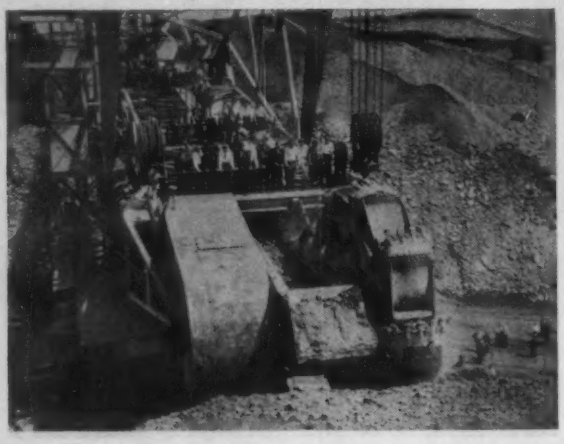
The system has enabled some mines to reduce drilling costs in as little as twelve months by as much as 23%, excluding bonuses earned for steel performances. Before anyone takes alarm at the bit footages reported here, let it be said that the contract rates are dependent on the type of ground being drilled—the uranium- bearing conglomerate in the Algoma Basin is one of the most abrasive possible, and the bit perform-

ances are considerably below (even for the best records) that of other Canadian camps. Under easier drilling conditions, Hard Metals is contracting bits at less than 2½c per ft.

Service is maintained in Elliot Lake by a field staff headed by Donald Fraser who is in constant touch with the mine operators and a centrally located plant and warehouse in Elliot Lake. The plant fabricates new steel, reconditions old steel and bits, making all pick-ups and deliveries on a regular weekly schedule.

Each mine's equipment is kept separate so that the bits and steel received from one mine are returned to the same mine after reconditioning. Bit sharpening goes on on a 24-hour return basis, while steel reconditioning takes 48 to 72 hours.

Contract rates also are offered for jumbo and drillmobile equipment, with three such contracts running in this area. Hard Metals also supplies a contractor on a road surfacing job nearby. In addition, Hard Metals supplied the bits and steel to McIsaac Mining & Tunnelling Co. on a tunnel driving contract at Northspan's Panel mine where what is believed to be a new North American tunnel-driving record was set. McIsaac also raised the Quirke shaft to provide new working levels without interfering with a single day's production.



Bucyrus-Erie Acquires Kolbe Bucket Wheeler Rights and Patents (2)

BUCYRUS-ERIE CO. has acquired the plans and patents for the Kolbe Wheel Excavator, the largest earth moving machine ever built in the U.S. The announcement was made at the first public demonstration of the machine June 17 at the United Electric Coal Co. Cuba Mine near Canton, Ill.

William L. Litle, board chairman of Bucyrus-Erie, told the gathering of more than 200 industrialists brought to the mine by special train from Chicago that while Bucyrus-Erie is not unfamiliar with wheel excavators—having designed and built wheels of its own—Mr. Frank F. Kolbe, president of United Electric, pioneered the use of wheel excavators in this country. He said the machine may be used in large scale strip mining or uranium and other big earth moving jobs in addition to its present application in the coal fields. Undoubtedly, still other applications will be found for this revolutionary machine as time goes on, Litle continued.

Bucyrus-Erie now has work underway on another wheel excavator for the Peabody Coal Co. for use at its River King mine near Freeburg, Ill. This wheel will incorporate features covered by the Kolbe patents.

The machine shown above is 46 ft wide, 150 ft high and weighs 2,100 tons. The wheel excavator gets its name from the use of a 27-ft diameter wheel with ten 2.5-cubic yd buckets on it. A chain mat forms the back of each bucket to provide continuous self-cleaning action.

Excavated material is discharged from the wheel to the belt over a roll feeder consisting of four steel rollers which rotate at speeds increasing from wheel to belt. The roll feeder performs three basic functions: allows buckets to dump at a lower position; permits using buckets of maximum width; and lets material cascade onto the belt without piling up.

From the ladder belt, the material drops onto the stacker belt. The material moves 420 ft from the wheel to the spoil pile.

The wheel cuts down overburden from 100 ft to 9 ft above the coal.

The wheel itself is powered by one 715 hp motor at 660 rpm continuous, and 1200 hp at peak kw. Variable speed control permits regulation for different conditions but 8 rpm of the wheel is considered normal speed.

The wheel is powered from the motor by a 30-in. Poly-V belt which helps provide the necessary clutching action to protect motor and reduce shock loads.

The ladder belt is driven by a 250 hp motor at 1200 rpm and the stacker belt is driven by two 400 hp motors.

Belt Repair Kit (6)

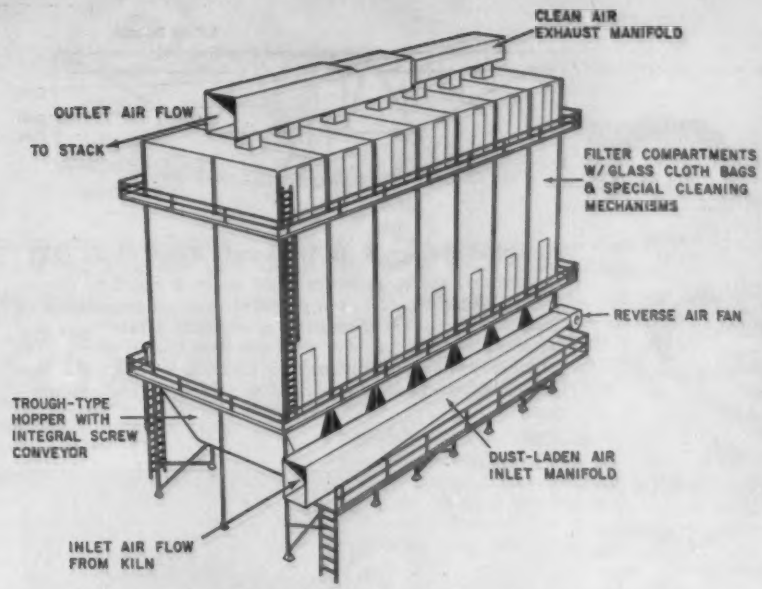
AUTOMATIC VULCANIZERS CORP. has on the market a conveyor belt repair kit consisting of chemically cold self-vulcanizing repair material under the Pang trade name which solves many of the problems involved in the maintenance and repair of conveyor belts.

The advantages of using Pang over other repair materials, such as belt fasteners, rivets, etc., are obvious. Other advantages are: (1) No alien matters such as metal plates and rivets which frequently cause pulley problems need be used. (2) Aside from the belt-splicing operation, the Pang patching job can be done by one man. (3) Unlike other vulcanizing material, Pang cures without heat and no special tools are required. (4) Pang's chemically cold self-vulcanizing materials make the conventional heat method obsolete. Pang can be used on all belting material.

Bowl Scraper (4)

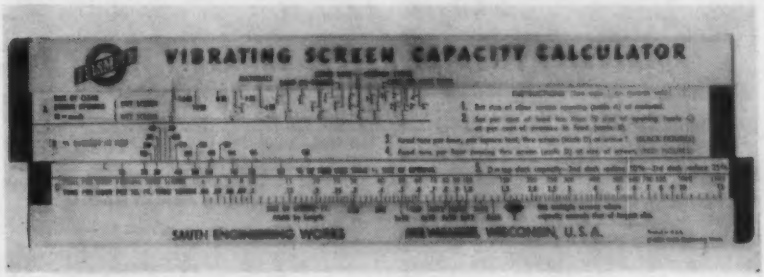
A HIGH HORSEPOWER, large capacity V-8 engine earthmover has been announced by LeTourneau-Westinghouse Co. Named the V-Power C Tournapull it is teamed with a 20-cubic yd C Fullpak Scraper. Engine is a 270-hp GM 8V-71, two-cycle diesel.

INFLUENCE Effluent Collector


CLEAN AIR EXHAUST MANIFOLD
OUTLET AIR FLOW TO STACK
FILTER COMPARTMENTS W/ GLASS CLOTH BAGS & SPECIAL CLEANING MECHANISMS
REVERSE AIR FAN
TROUGH-TYPE HOPPER WITH INTEGRAL SCREW CONVEYOR
DUST-LADEN AIR INLET MANIFOLD
INLET AIR FLOW FROM KILN

Glass Filter Cloth Used in Cement Plant Collector (24)

SEVEN-COMPARTMENT dust collector, which was installed at an eastern cement plant as an air pollution countermeasure by Dracco Div., Fuller Co., employs sonic cleaning through a patented Sonoclean system. Glass bags are specially treated to avoid fracture and can be used to collect all materials except fluorides at up to 600 deg F. Dracco baghouse is reported to be 99% efficient on such tough collecting jobs as cement kilns, metallurgical furnaces, calciners, etc. Two other bag cleaning methods are available other than the Sonoclean—reverse air flow and a patented Swing-Clean system. The later system imparts a gentle downward wave or oscillation to the bag to remove collected dirt, rather than the violent shaking and rapping common to some baghouse systems.

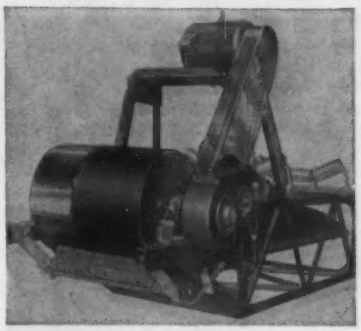


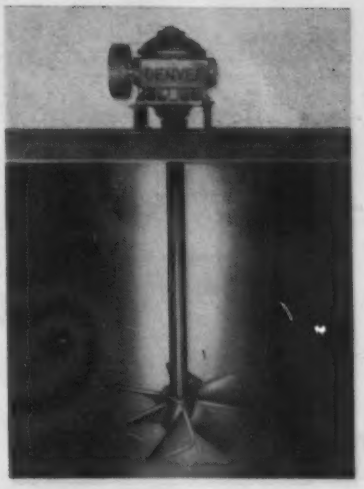
Slide Rule Helps Determine Screen Capacity (23)

HANDY SLIDE rule from Smith Engineering Works will help an operator select and buy the best and most economical size vibrating screens to suit his particular needs. It takes into account the kind of material, screen opening size, percent oversize in feed, percent of feed less than one-half passing size, opening shape, number of decks and deck slope. Free upon request.

Conveyor Belt Drive (32)

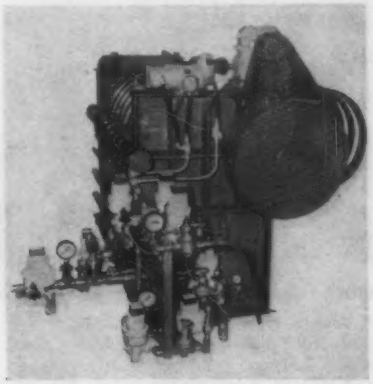
BETTER BALANCE, greater accessibility, quieter operation, factory assembly and long-life are some of the features cited by Barber-Greene about their new series of standardized torque-arm belt conveyor drives. These are complete units, available in a wide variety of belt widths and horsepower ranges. All speed reduction is accomplished through V-belt sheaves and a double reduction reducer.





Powerful Agitator Drive (25)

AGITATOR drive, capable of driving 120-in. dia propellers for tanks up to 50-ft dia and 40-ft deep has been developed by Denver Equipment Co. Unit has worm gear drive, special bearings to carry all radial and thrust loads and mechanical efficiency of 90%. Unit with large diameter propellers has been used on heavy magnetite suspensions, large mesh alumina holdings, potash conditioning, and uranium leaching and precipitation. Propellers can be standard or rubber-covered construction.

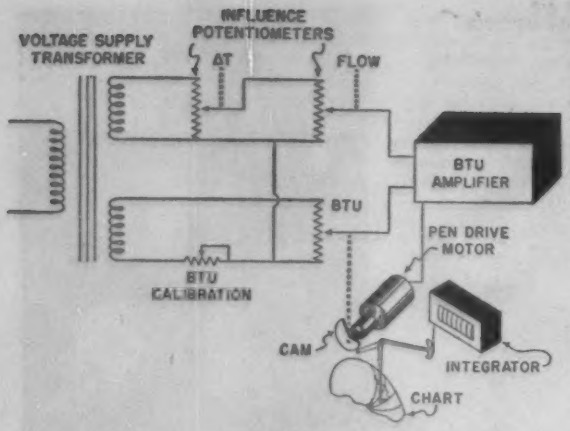


Automatic Eimco-Burwell (28)

A FULLY-AUTOMATIC version of the improved Eimco-Burwell filter has been built by Eimco Corp. The filter is equipped with an electric timing control circuit which permts the filter to start and stop a filtering cycle without the attention of the operator. Unit was built for an eastern metal processor and has eight 32-in. dia frames.

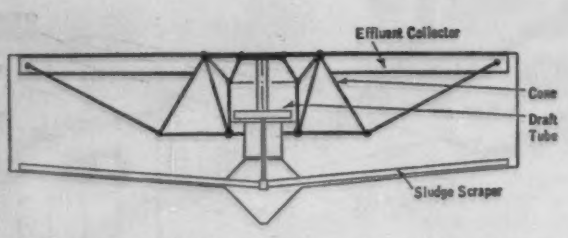
Rubber-Lined Pump (41)

ALLIS-CHALMERS MFG. CO. extended the capacity range of its rubber-lined pumps with the addition of a 14x12 in. unit capable of handling 8,000 gpm at heads up to 140 ft at 870 rpm. Pump handles abrasive slurries minus ¼ inch round.



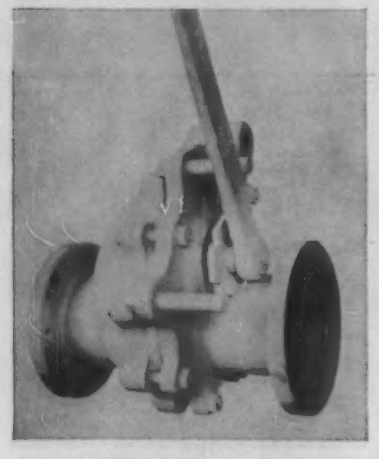
Recorder Measures Heat Transfer (36)

A SINGLE recorder is used to continuously record, indicate and integrate Btu loss or gain of a flowing liquid in the Hays Corp.'s Model 913 Btu meter. Also on the same chart, temperature differential and flow rate of the liquid are recorded. Primary use of the Btu meter is control of heat transfer in hot water generators, cooling towers, refrigeration systems and other processes involving changes in heat content.



Patented Design Cuts Thickener Rake Costs (37)

THE INVERTA-TRUSS, as the patented design is called by Graver Water Conditioning Co., will permit economical construction of thickeners up to 200 ft or more in diameter. Graver says that the cost of a Reactivator or thickener rises sharply above 75-ft dia, due to the conventional construction of the rake arm bridge. Inverta-Truss design requires less steel, less reinforcement.

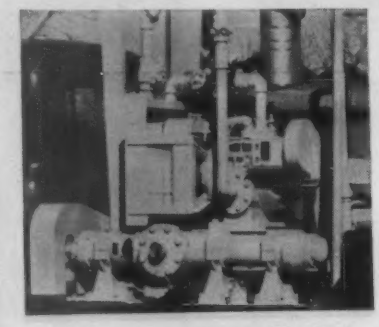


Gate Valve (31)

A SLURRY-TYPE gate valve has been introduced by the Everlasting Valve Co. which features a unique interior shape and sloping sides on the valve disk to recirculate the slurry in the body chamber when the valve is being opened or closed. Valve may be hand or air operated and is available in a 4-in. size, iron body. Other materials of construction can be ordered, including hard-faced disk and seat face.

Microcinematograph (42)

WILD HEERBRUGG INSTRUMENTS has a microcinematographic attachment called the Cinetube that permits critical focusing on specimens while taking moving pictures through the Wild M20 microscope. No need for an eyepiece with adjustable lens or a mechanical adapter to provide a predetermined distance between the attachment and the image plane.

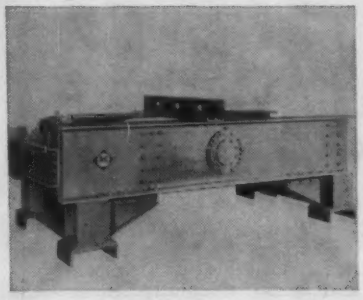


For High Pressure Drills (43)

AS DRILLING rigs are called upon to reach further and deeper into the earth, air pressures needed for these deeper penetrations go up—two and even three-stage compressors are becoming a necessity for many operations. Allis-Chalmers Mfg. Co. has sold many of these two-stage units where air pressures of 100 psi (normal) and 175 (momentary) are desired. Allis-Chalmers has developed a three-stage unit capable of maintaining 250 psi with momentary peaks to 300.

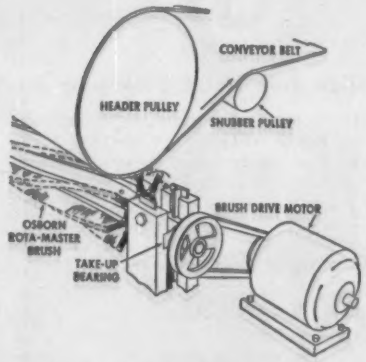
Portable Power Pack (44)

A LOW-COST silicon mine power supply consisting of a rectifier car and transformer car has been announced by General Electric Co. Only 30-in. high, the portable equipment is 28% lower in height than a comparable mercury-arc rectifier, making the silicon unit particularly suited for low-seam mines. Called the Lo-Boy, the silicon units are available in ratings from 300 to 750 kw, 275 to 550 v, dc. They are designed to withstand 150% of rated current for two hours; 200% for one minute. Regulation is only 7% from "no load" to "full" and efficiency is 95%.



Gondola Car-Shaker (45)

EXPANSION of the Allis-Chalmers Mfg. Co. line of car shakers for unloading of granular materials from open, hopper-bottom gondola railroad cars has been announced by the company with the addition of a 3.5-ton unit. Smaller design is capable of unloading the same materials as the 5-ton unit, except that unloading time will be longer for frozen or sticky materials. Company suggests the smaller unit if you are unloading only 4 to 5 cars a day.



Conveyor Belt Brush (30)

TO CLEAN the carry-back from conveyor belts, Osborne Mfg. Co. has developed a plastic bristle (Korfil P) brush with an aluminum housing that fits under the head pulley, and is driven by its own motor and take-up bearing. Plastic brushes can be readily replaced, and they are extremely resistant.

For Your Files

This selected manufacturer's literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

NEW METHOD of area measurement developed by Phototronix, Inc. provides an automatic link between aerial photogrammetry and electronic computation of the area, stockpile or open pit. Method is explained in literature and a reprint from PIT & QUARRY. **(47)**

AIR HOSE for all kinds of service—heavy-duty, light-duty, welding, manifold lines, etc.—is illustrated in an eight-page catalog (330) from U.S. Rubber Co. **(48)**

WATER HOSE catalog (395) from U.S. Rubber covers every type available from the company. 8pp. **(49)**

A CATALOG from Sauerman Bros., Inc. contains complete specifications, tonnage capacities and recommended wire rope sizes for Sauerman Durolite blocks and sheaves. 10pp. **(50)**

ROTARY GUN drilling machines available from Stardrill-Keystone Co., Div. of Koehring Co. are listed in an illustrated eight-page bulletin (KS-635). **(51)**

WIRE ROPES—the J&L Plastikore and Springkore designs—are illustrated in a four-page bulletin from Jones & Laughlin Steel Corp. (AD-250). **(52)**

JALKLAMP, a special J&L product to end your wire rope splicing problems, is illustrated in a four-page bulletin (AD-253) from Jones & Laughlin steel Corp. **(53)**

MEDIUM CAPACITY, 15- to 40-hp slushers are the subject of an illustrated bulletin covering the Joy Mfg. Co.'s A and B class slushers. (76-J). **(54)**

INSTRUCTIONS and maintenance data on Gould-National Batteries, Inc. line of lead acid batteries are available in a 36-page 5x7½-in. booklet. **(55)**

NICKEL-CADMIUM batteries using the sintered-plate design are illustrated in a four-page bulletin from Nife Inc. **(56)**

COMPLETELY automatic control of engine-compressors is described in Ingersoll-Rand Co.'s four-page bulletin on the Tendamatic unit. **(57)**

CRAWLER TRACTOR—the HD-16—is featured in a fold-out cutaway in a 14-page catalog (MS-1318) from Allis-Chalmers Mfg. Co. **(58)**

CRAWLER TRACTOR—the HD-6 with 66½ net hp—is presented in a 16-page catalog (MS-1251) from Allis-Chalmers Mfg. Co. **(59)**

BOWL SCRAPER Model TS-260 from Allis-Chalmers Mfg. Co. is powered by the new A-C 16000 diesel engine that develops 230 hp according to a 16-page catalog (MS-1312). **(60)**

OFF-HIGHWAY TRUCKS in Letourneau-Westinghouse Haulpak line can be examined through a 24-page brochure. Haulpak line has many revolutionary features and is available in several sizes and dump arrangements. **(61)**

WHEELED CRANE, the 30-ton Lorain Moto-Crane Model MC-430, is presented in a 12-page bulletin from Thew Shovel Co. **(62)**

A NEW NAME in tractor shovels—the N. P. Nelson Iron Works, Inc. has developed a 2¼-cubic yd. four-wheel drive tractor shovel with full Torqmatic drive, according to a four-page catalog on the Model 200 machine. **(63)**

CRAWLER crane excavator with 40-ton capacity and designated the American 500 Series is the subject of a 24-page bulletin from American Hoist & Derrick Co. Unit easily converts to a crane, dragline, clamshell, backhoe or pile driver. **(64)**

BOWL SCRAPER—Caterpillar Tractor Co.'s Lowbowl No. 442 (14-cubic yd struck) and the wheeled tractor No. 619 are featured in a six-page bulletin (33451). **(65)**

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E&MJ NEW PRODUCTS DIGEST (*Continued*)

AIR COOLED diesel engines in a variety of horsepower ratings are cataloged in literature from R. A. Lister & Co. Ltd. Rated horsepowers available range from 3½ to 33 at 1800 rpm. **(66)**

OPERATING and service manual on C&D batteries is available from C&D Batteries, Inc. Manual covers operating, maintenance, charging, trouble-shooting and repair in 48 pages. **(67)**

PLASTIC PIPE for electrcal conduit service is offered by Southwestern Plastic Pipe Co. according to six-page specification sheet. **(68)**

PROCESS PUMPS in the Lawrence Pumps, Inc. line are discussed in a 20-page bulletin (203-B) which stresses that the pump type must be chosen for the duty. **(69)**

CONTROL VALVES bulletin (150) from DeZurik Corp. lists all the valve bodies, actuators and accessories available from the company. 19pp. **(70)**

GEARMOTORS in the Jones Machinery Div. line of Hewitt-Robins, Inc. are detailed n a 32-page bulletin (J-17). Capacities up to 125 hp and a variety of output speeds from 780 to 1.2 rpm are available. **(71)**

DRY CENTRIFUGAL dust collector —the AmerClone design of American Air Filter Co., Inc.—is detailed in an eight-page bulletin (291A). **(72)**

EQUIPMENT, systems and controls for the process industry are featured in an eight-page bulletin (5-1) from B-I-F Industries. **(73)**

PROPELLER and mixed flow pumps in the Layne & Bowler, Inc. line are introduced in a six-page bulletin. Pumps are designed for low head, large volume (to 100,000 gpm) output. **(74)**

DECO TREFOIL for May-June discusses flotation of moly at Anaconda's Chuquicamata plant and gives complete details on the Fremont Minerals, Inc. 550-tpd uranium leaching mill at Riverton, Wyo. **(75)**

COAL PREPARATION PLANT equipment available from Dorr-Oliver Inc. is illustrated in an eight-page bulletin (7101).. **(76)**

CLASSIFYING SYSTEMS developed by Buell Engineering Co., Inc.—Centrifugal Classifier and the Gravitational Classifier—are presented in a four-page bulletin. **(77)**

COMPLETE size range of adjustable joints for spraying nozzles are tabulated in literature from Spraying Systems Co. **(78)**

VIBRATING screen separator, the De Laval Separator Co.'s Syncro-Matic Separator, is discussed in a two-page bulletin (SA 1101-12-58). Syncro-Matic has high throughput potential and features three dimensional motion, each individually controlled—gyratory, horizontal and vertical. Multiple decks or single available. **(79)**

ELECTRONIC air cleaner developed by American Air Filter Co. is described in detail in a 16-page bulletin (249-A). Rollotron operates by combining the features of an electrostatic precipitator with an automatic, renewing, disposable filter media separator. Unit needs no water, washing or drains and no oiling of plates is required. **(80)**

LOAD CELLS and servo system data presentation are the main features of the Ametron Electronic line of crane, tank, hopper, larry car and truck and track scales. Literature available. **(81)**

HAMMERMILLS built by Iowa Mfg. Co. in the Cedrapids line are presented in a four-page bulletin (HM-2). **(82)**

COATED FABRIC GLOVES—six complete lines—are illustrated in American Optical Co.'s four-page bulletin. Selection chart helps pick the right material for any particular process fluid being handled. **(83)**

FEEDERS in the Cedarapids line of Iowa Mfg. Co. are presented in a bulletin (FE-1). Apron and reciprocating types are available. **(84)**

SPECIAL INDEX ISSUE to the Rohm & Haas Co.'s AMBER-HI-LITES review is available from the company. The periodical reviews all the published material on ion exchange resins, their use and reactions. **(85)**

THE LATEST INFORMATION on the high efficiency screening machines—the Novo System—which employ sound vibrations to assist sifting action is available from NoVo Div. of Industrial Enterprises, Inc. See NPD Item No. 2, p45, April 1958 E&MJ for photos of the Novo filter and screen. **(86)**

AMERICAN FILTER for continuous dewatering of metallurgical concentrates is the title of an eight-page bulletin (7202) from Dorr-Oliver Inc. **(87)**

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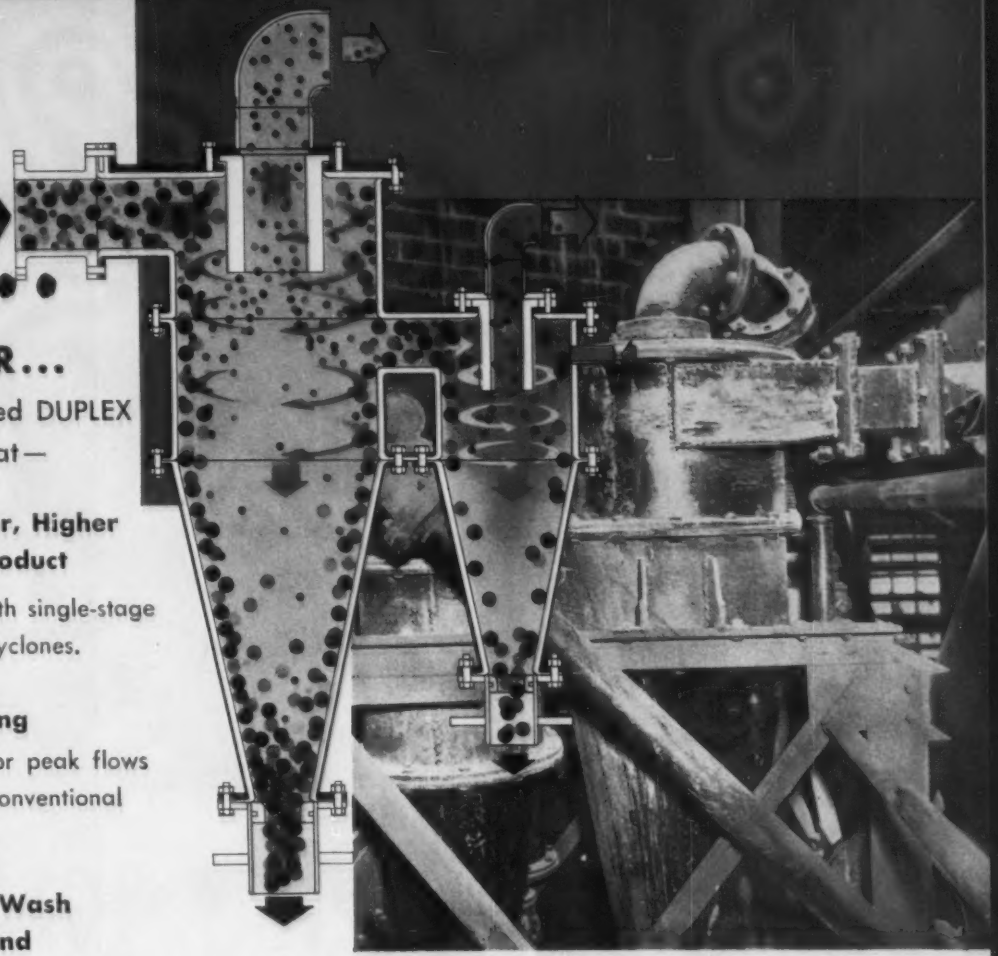

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(2) Is Self Regulating

—handles surges or peak flows that would plug conventional wet cyclones.

(3) Uses Water to Wash Slimes From Sand

to give sharp separation, clean, slime-free product.

Complete details on the DENVER-Morton Duplex Cyclone Classifier will be sent to you on request. Write today!

"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEERS — STANDARD RELIABLE 24 HOUR SERVICE EFFICIENT

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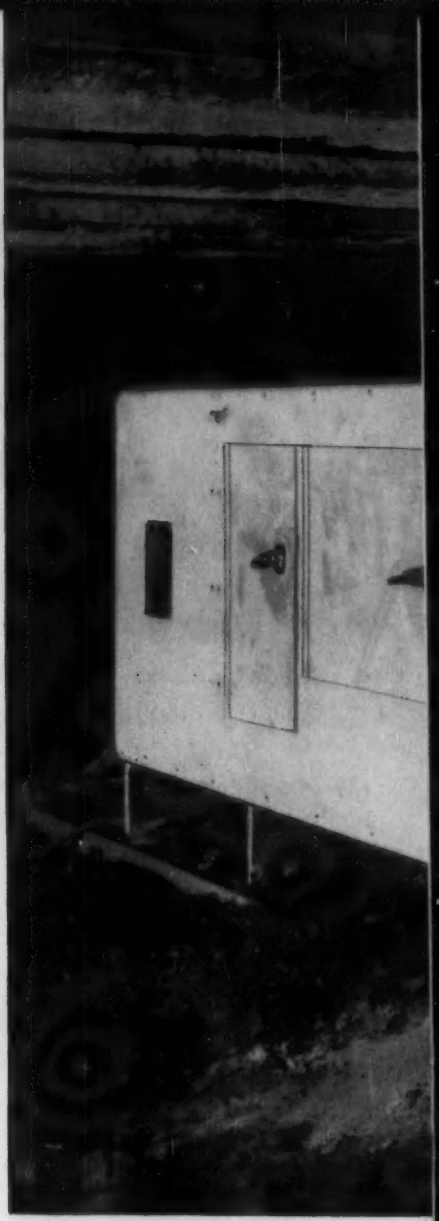
ONLY WESTINGHOUSE CONSTRUCTION SUITABLE FOR WORLD'S LARGEST SEALED DRY-TYPE MINE POWER CENTER



MINE power center specifications are extremely exacting . . . so exacting that only Westinghouse, the leader in the field, offered a construction found suitable for the world's largest sealed, portable mine power center.

Only Westinghouse construction could combine—in a unit with the desired 600-kva, 7200/480-volt rating—the necessary ruggedness, compact low height and light weight essential to easy portability within mine tunnels.

Here are the key features in this construction:

External ruggedness—A ¼-in. steel plate case protects against roof falls, rough use. A ⅜-in. base plate with ½-in. reinforcing skid runners protects the unit when skidded over rough bottom, haulage tracks, etc., during frequent relocation.

Internal ruggedness—Core and coils braced at both top and bottom to withstand full short circuit conditions, securely mounted in case to withstand moving and rough handling.

Low height—The most compact mine power centers made, the 600-kva unit is only 42 inches high, the 300-kva unit only 36 inches.

Low maintenance cost—Nitrogen-filled, sealed, dry-type power center is practically maintenance-free; protected against moisture even when de-energized during prolonged shutdowns.

This sealed mine power center is but one of the complete line of Westinghouse power centers available to serve the mining industry above the surface, as well as below. Ask your Westinghouse representative about the power center to serve your specific applications.

J-70899

YOU CAN BE SURE...IF IT'S

Westinghouse

WATCH WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

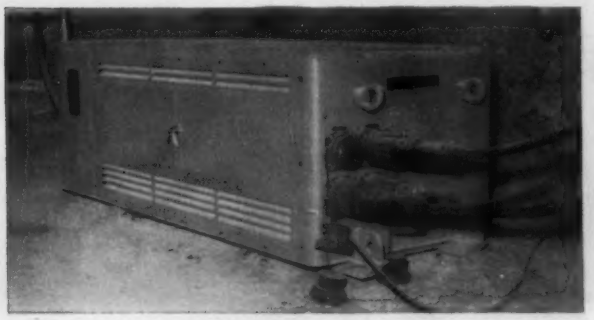
DIAPHRAGM PUMPS

AUTOMATIC SAMPLERS

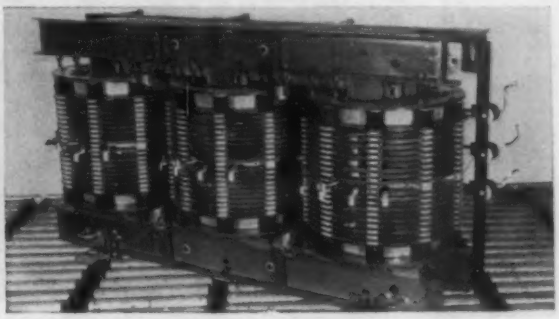
DRYERS

Convenient location of the high-voltage receptacle on world's largest sealed mine power center permits hitching to low-voltage end when unit is skidded to a new location. This allows unit to remain energized; high-voltage cable can pull straight without bending, and buggy can obtain its motive power from one of the secondary feeders.

A full range of ratings in ventilated mine power centers is available from Westinghouse for application where conditions are less severe—such as less dust, lower humidity.



Core and coil assembly for 600-kva, 7200/480-volt, 3-phase unit—world's largest sealed mine power center made by Westinghouse.



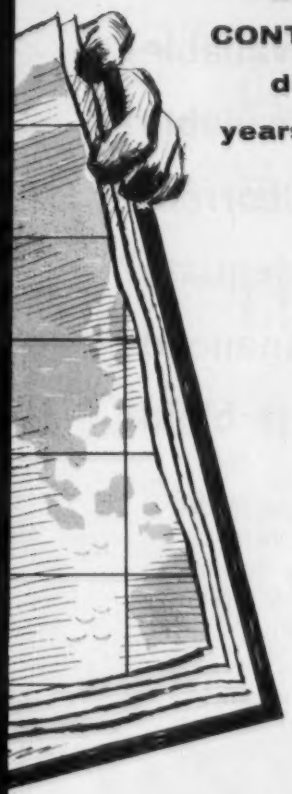
THE
WORLD IS AN

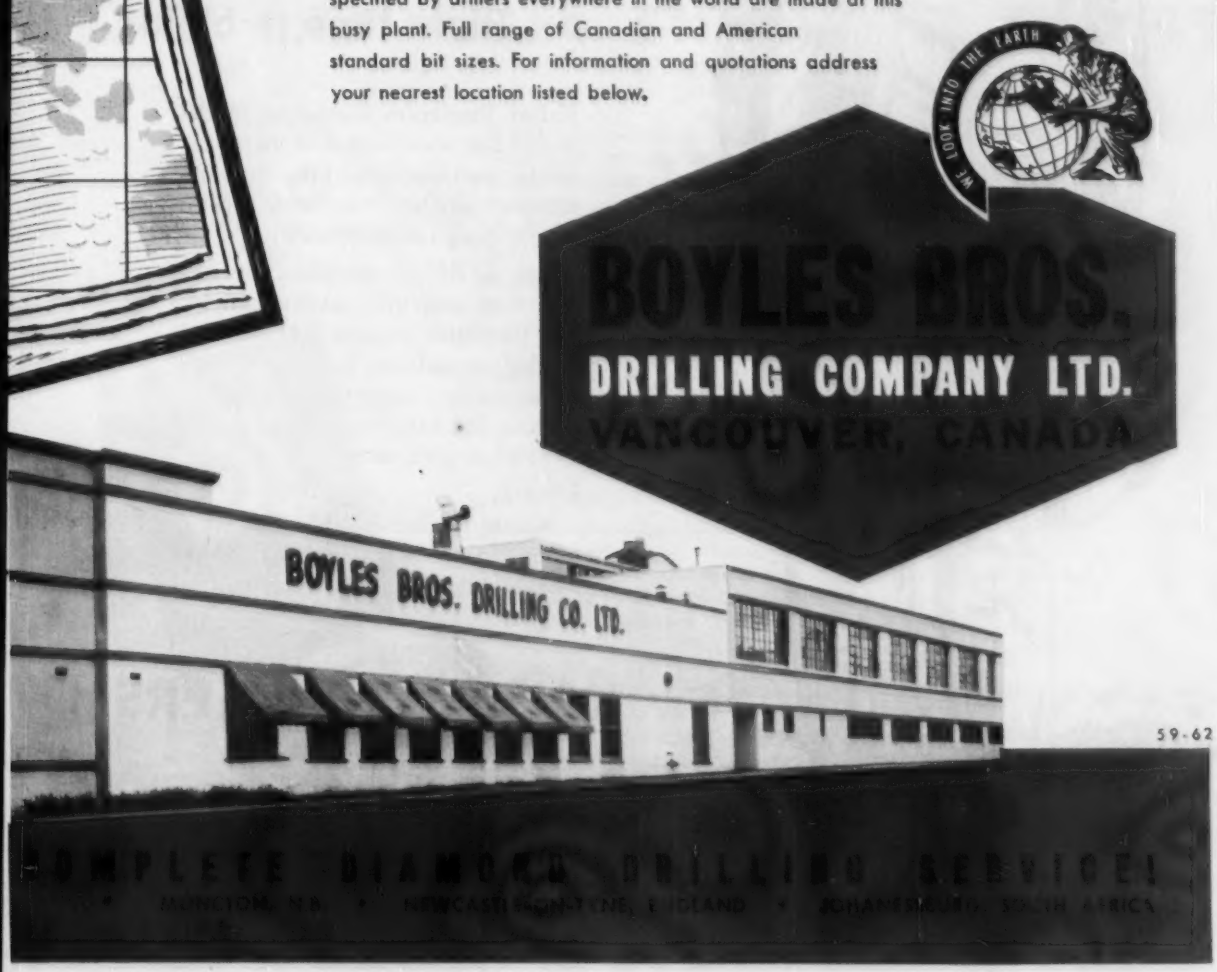
OPEN BOOK" TO BOYLES BROS...

...more than ten million feet drilled in the past ten years. Behind Boyles Bros. leadership in both diamond drill CONTRACTING and the MANUFACTURING of diamond drilling equipment, is more than sixty years of experience.

That's what you get when you buy Boyles Bros service or equipment. Whether it's core drilling, blast-hole drilling — grouting — soil sampling — foundation or oil structure testing. Whatever and wherever your drilling problems are, you'll do better with Boyles Bros.

Vancouver, B.C. Head Office and main manufacturing headquarters occupies a full city block. Boyles Bros. drilling equipment, diamond bits and other products specified by drillers everywhere in the world are made at this busy plant. Full range of Canadian and American standard bit sizes. For information and quotations address your nearest location listed below.





Your new plant or expansion idea

Raw materials available?

Market available?

Location correct?

Capacity adequate?

Readily financed?

Right time to build?

Kaiser Engineers specializes in the design and construction of major facilities used throughout the Minerals industry, and has world-wide experience in design of such facilities.

Among KE's most valued services are sound, searching, economic analyses, feasibility studies and site and market evaluations. In a word—*Pre-Engineering*—impartial, outside analysis which helps you decide whether to proceed with, defer or modify the project.

Kaiser Engineers offers you cost-saving, time-saving one-company service from concept through start-up.

KAISER ENGINEERS

Division of Henry J. Kaiser Company
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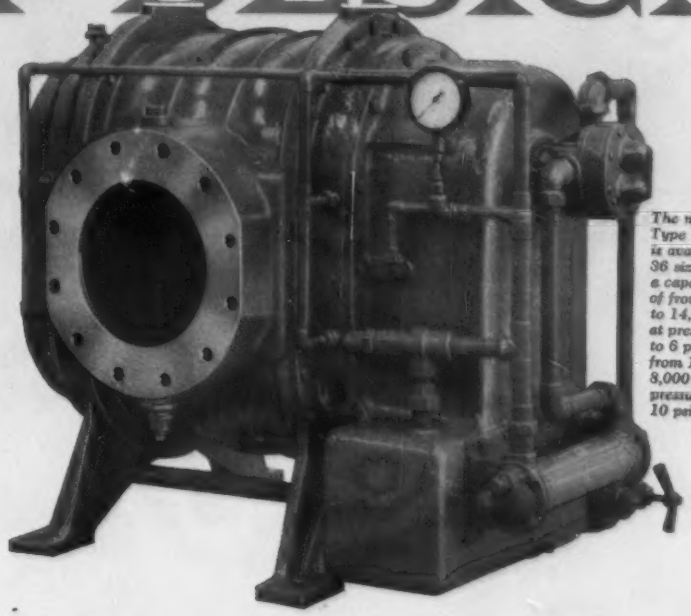
Pittsburgh, Washington, D. C., Chicago, New York

• KE projects include work in Australia, Brazil, Ghana, India, New Zealand, as well as Canada and the United States. Assignments include iron ore concentrating plants, cement plants, bauxite and alumina processing plants and diatomaceous earth facilities.

5459-M

NEW-DESIGN

R-C blower delivers more CFM



The new R-C Type RAS Blower is available in 36 sizes covering a capacity range of from 2,000 to 14,000 cfm at pressures to 6 psig and from 1,500 to 8,000 cfm at pressures to 10 psig.

AT LOWER POWER COST

A new, high-performance R-C rotary positive blower (designated Type RAS) features two important design improvements. *First*, a new "segment waist" impeller contour that increases the volumetric efficiency of the blower. *Second*, a new vertical arrangement of the impellers that increases application flexibility.

The design of the "segment waist" impeller contour permits a higher pressure rating for a given impeller length. This in turn delivers greater displacement per revolution without increasing operating speed and at a lower power cost. And, in addition to being more quiet in operation, the design permits safe handling of entrained liquids.

The vertical arrangement of the impellers provides horizontal inlet and discharge connections for more convenient, simplified piping. Extremely compact, the blower also offers substantial savings in space requirements. And, as with all R-C rotary positive blowers, air delivered is free from oil vapors and other contaminants.

Roots-Connersville RAS blowers offer many advantages—exclusive rotary positive design, ease of installation, efficiency of operation, and long years of trouble-free service. These features are the result of R-C's specialized experience of more than 100 years in the design and application of air and gas handling equipment.

For gas service too... This same new design is also available in pumps for gas service. Designated Type RGS, the gas pumps differ from Type RAS Blowers only in that a mechanical face type seal is used instead of a lip seal.

For additional data, please refer to pages 565-568 in **Chemical Engineering Catalog**, *our section in* **Mechanical Catalog**, *or write for* **Bulletin RAS-158.**

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
959 Washington Ave., Connersville, Indiana. In Canada—
629 Adelaide St., W., Toronto

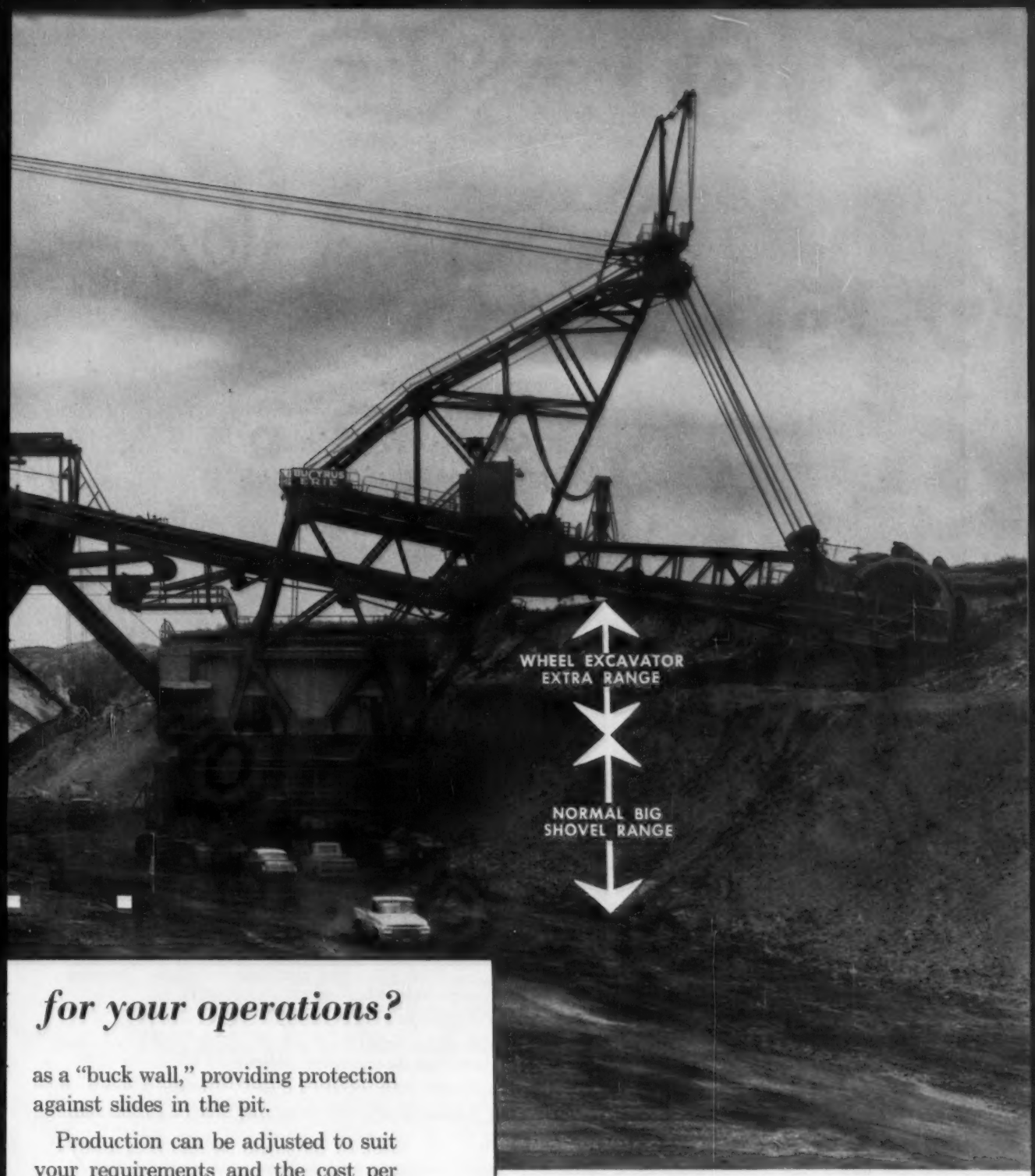
MEET THE WHEEL EXCAVATOR .

...have you considered this revolutionary machine

Take a close look at the unique abilities of the Bucyrus-Erie wheel excavator. Perhaps it is the answer to your large-scale excavating, stripping and high-volume dirt-moving problems.

In the coal fields for example, Bucyrus-Erie wheel excavators team up with present big shovels and make it possible to uncover veins previously too deep for practical stripping... thereby increasing strippable reserves and extending the use of present equipment.

The "wheel" can deposit the unstable material, normally occurring near the top of a mine cut bank, far back onto the spoil pile. The stripping shovel places the more stable material from the lower part of the bank at the bottom of the spoil pile where it acts



for your operations?

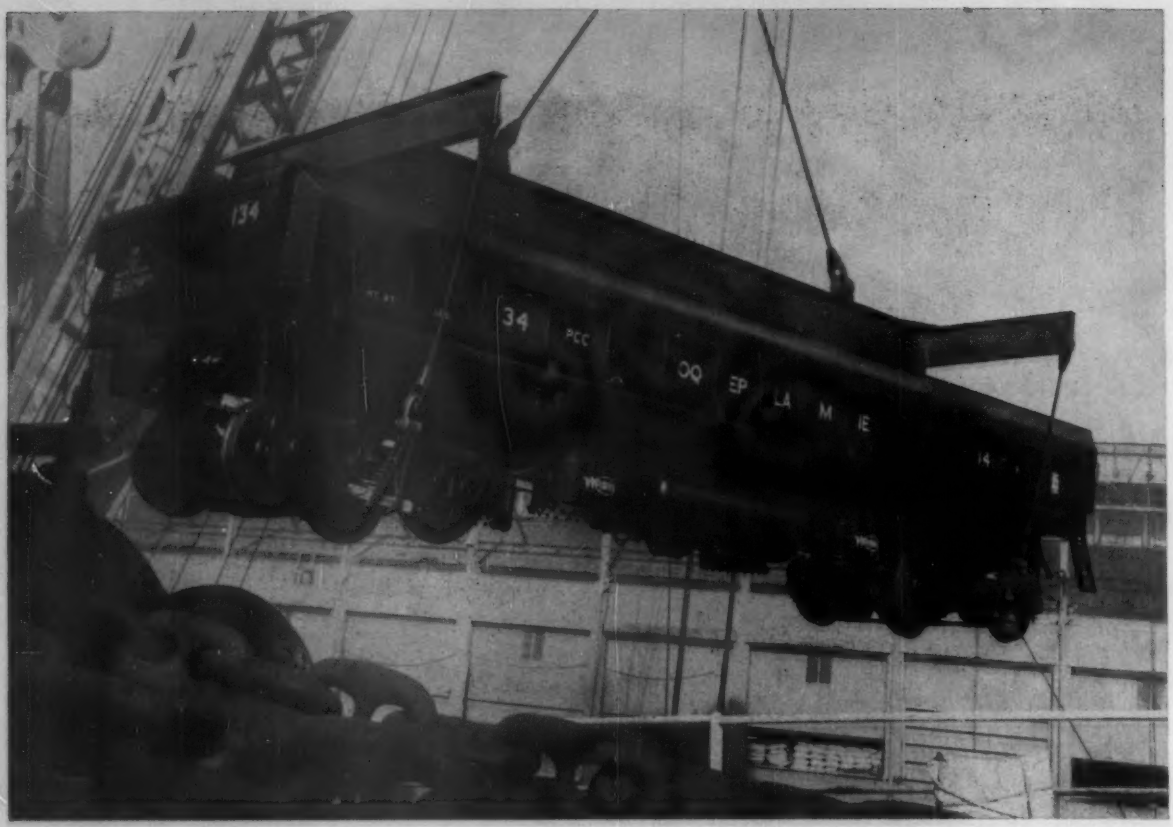
as a "buck wall," providing protection against slides in the pit.

Production can be adjusted to suit your requirements and the cost per cubic yard of material dug is lower than by any other method.

For details on how a wheel excavator may be applied to your operations consult Bucyrus-Erie Company, South Milwaukee, Wisconsin, Dept 5LF.

BUCYRUS ERIE®

Builds Better Equipment



Being hoisted aboard a ship bound for Peru is one of 85 new Western dump cars slated for use at the new Toquepala copper mining project.

For Southern Peru Copper . . .

85 built-to-take-a-beating Western dump cars

Cars that transport copper ore from the open-pit mine to the concentrator at the mammoth new Toquepala project in Peru, about 55 miles from Ilo, have to be rugged. Loads of this heavy, dense material call for cars that can stand up under steady battering. That is one of the big reasons why Southern Peru Copper Corporation of New York chose Westerns.

The cars ordered were specially built of heavy-gauge, double-reinforced steel. Weighing 87,000 lb. and measuring approximately 43 ft. by 11 ft., they have a level full capacity of 43 cu. yd., or 90 tons.

Western dump cars also embody these features that have made their name synonymous with profitable operation:

- Door control mechanism, located at ends of car—substantial, fully enclosed, foolproof
- Exclusive dual side-pivots, permitting dumping with least effort and air consumption
- Fast-acting dumping mechanism and steep dumping angle to speed up operation, cut costs
- Automatic cut-off valve for smooth dumping
- Body underframe of one all-welded unit heavily reinforced throughout to prolong car life
- Double-plate, curved-top door, strongest made
- Low center of gravity to assure stability in all situations

Built by B-L-H's Eddystone Division, Western dump cars are available in any size up to 60 cu. yd., any capacity up to 100 tons. Write us for complete information.

BALDWIN · LIMA · HAMILTON

Eddystone Division

Philadelphia 42, Pa.

Hydraulic turbines • Weldments • Dump cars • Nonferrous castings • Diesel engines • Special machinery • Bending rolls • Ship propellers

12" BLASTHOLES drilled CONTINUOUSLY in any rock... Here's the ONLY drill that can do it!

Joy 60-BH Drill in operation in a large Southwest copper mine.

the JOY 60-BH Super Heavyweight Champion

Here's the champion at drilling larger, lower-cost blastholes where the going is tough and high production is a *must*. The Joy 60-BH Super Heavyweight Champion has the power, the stamina . . . the sheer muscle . . . to bottom blastholes fast, shift after shift, month after month, in hard or soft formations. And it can drill out of the hole, too, when necessary. Here's why the performance of this big drill cannot be matched—it excels *in all three* of the features which determine bit penetration:

STRONGER ROTATION—Up to 14,850 ft. lbs. of torque can be applied *continuously* and safely. Accurate control of infinitely variable bit speeds and constant indication by gauge.

HIGHER BIT PRESSURE—Joy hydraulic-feed method of applying bit pressure—gripping the rod at the most logical place, near the collar of the hole—permits *continuous* pressures up to 75,000 lbs.; assures more accurate control than other methods.

MORE EFFICIENT CUTTINGS REMOVAL—Only Joy uses a heavy-duty, industrial-type, water-cooled air compressor to insure an optimum, continuous air supply.

Other features . . . rod handling device to reduce heavy rod handling and the longest derrick available to reduce or eliminate rod additions.

Only Joy has a complete line of rotary air-blast drills:

56-BH	6¼" maximum hole diameter
58-BH	7⅞" maximum hole diameter
59-BH	9" maximum hole diameter
60-BH	12" maximum hole diameter

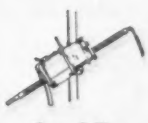
Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.
In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 251-4

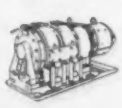
Consult a Joy Engineer

WSW M7230-251

JOY . . . EQUIPMENT FOR MINING . . . FOR ALL INDUSTRY



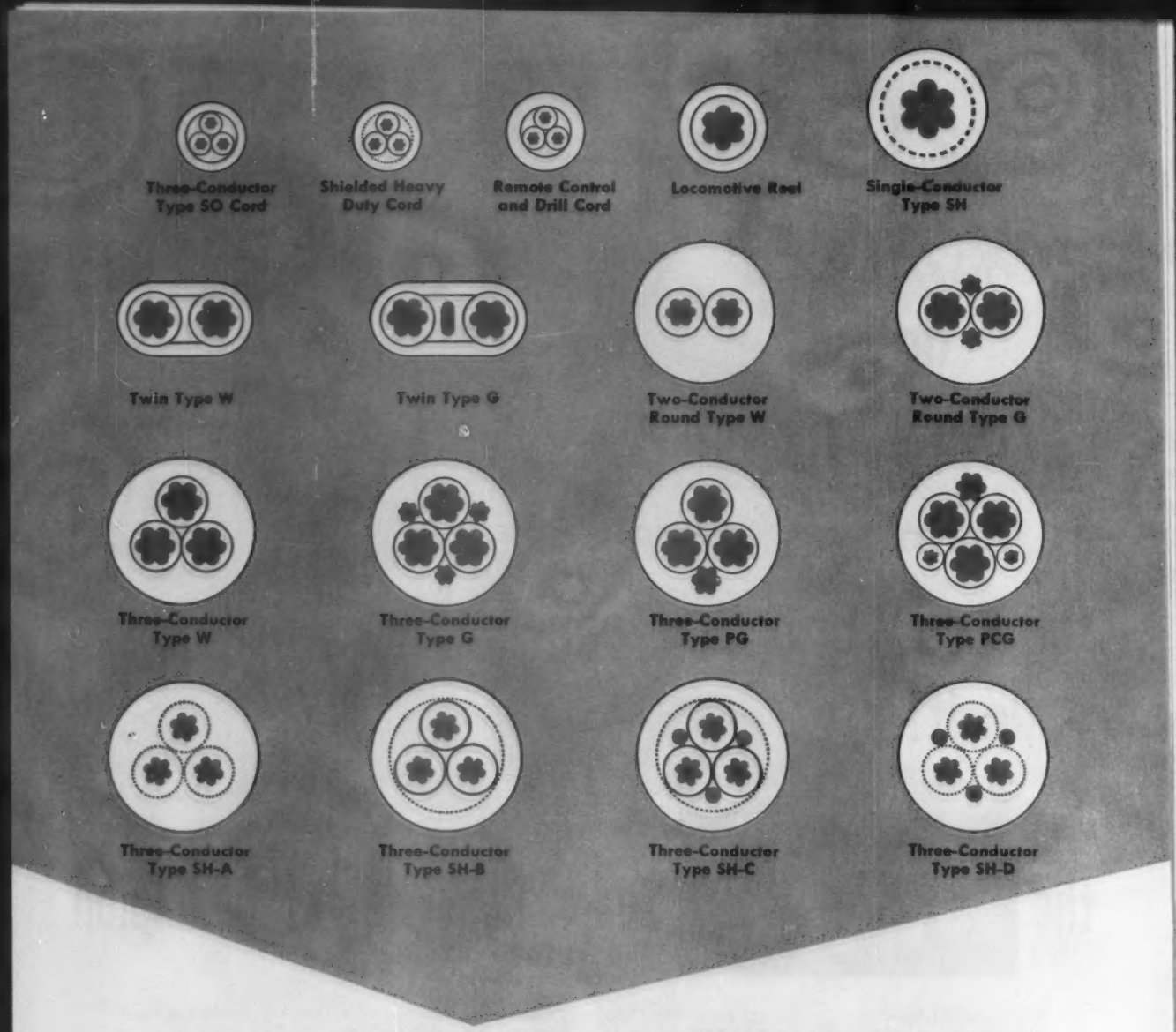
Core Drills



Slushers

Rock Bits

Drillmobiles



These OKOCORD cords and cables make tough mining jobs easier

Here are 17 of the basic Okocord constructions Okonite has developed for mining applications . . . for shovels, locomotives, shuttle cars, continuous miners and other equipment.

These tough, mold-cured flexible cords and portable cables are manufactured under the industry's strictest quality control program. Their rugged reinforced Okoprene jacket has superior flame resistance . . . plus the extra durability and flexibility that result from curing in a continuous metal mold. Insulation is tough, resilient and heat-resisting. Okocord conductors flex easily because they are formed with many fine gauge wires, twisted together with a short lay. And all Okocord cords and cables are color coded for easy phase identification.

If there isn't a standard Okocord cord or cable to meet your need, Okonite will design one . . . for *any* operation.

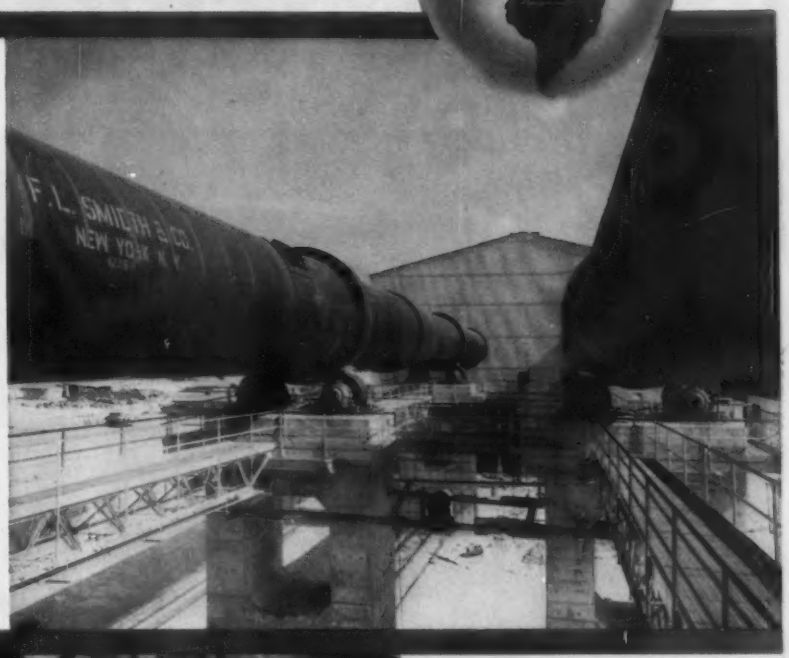
For the full story on Okocord cords and cables write for free BulletinEM -1108, The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

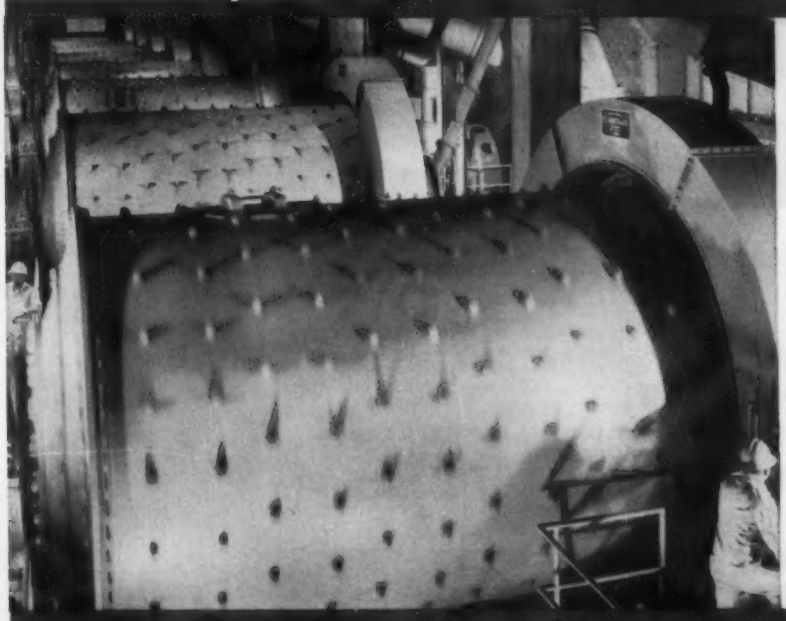
where there's electrical power . . . there's **OKONITE CABLE**

SMIDTH

rotary kilns

For sintering, nodulizing, calcining, desulphurizing, oxidizing and reducing roasting. Coolers, precoolers, preheaters, recuperators.
Auxiliary equipment for Rotary Kiln Plants.





grinding mills

Ball mills, tube mills and multicompartment mills—open or closed circuit—wet or dry grinding.
Also airswept for grinding and drying.
Over 1250 Smidth Rotary Kilns and over 5000 Grinding Mills supplied all over the world.

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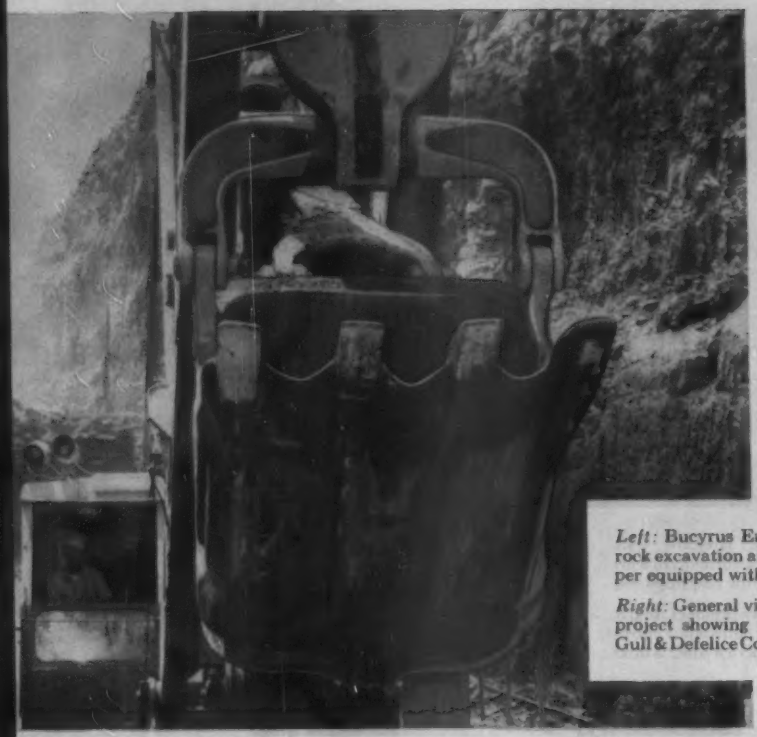
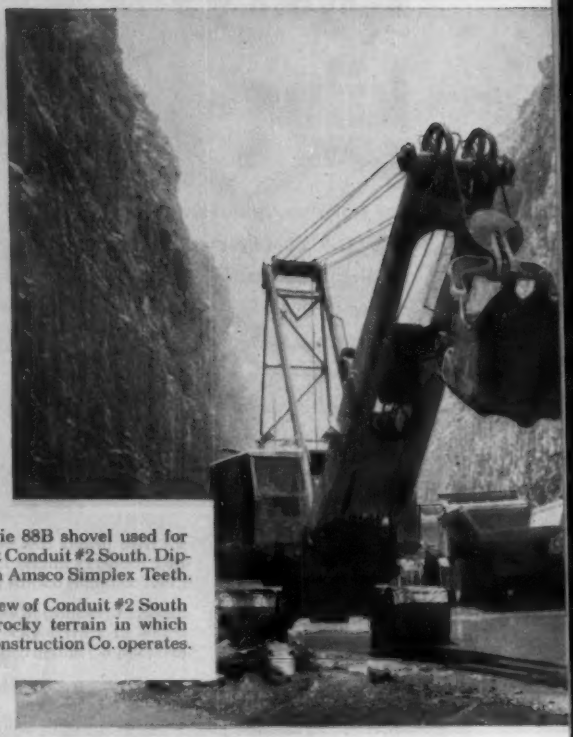
Bombay, India

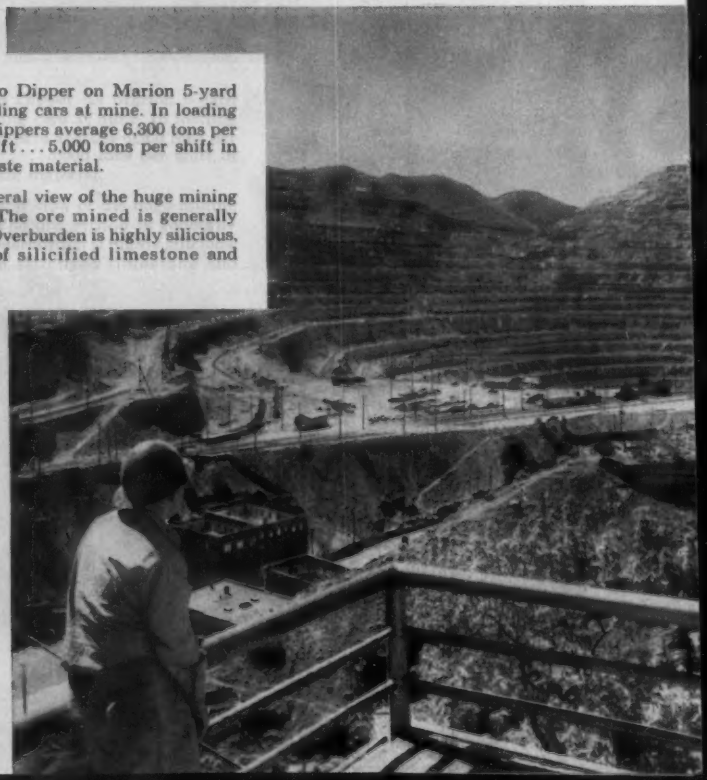
How AMSCO helps you MOVE





Left: Bucyrus Erie 88B shovel used for rock excavation at Conduit #2 South. Dipper equipped with Amsco Simplex Teeth.

Right: General view of Conduit #2 South project showing rocky terrain in which Gull & Defelice Construction Co. operates.



Left: Amsco Dipper on Marion 5-yard shovel, loading cars at mine. In loading ore, these dippers average 6,300 tons per 8-hour shift . . . 5,000 tons per shift in working waste material.

Right: General view of the huge mining operation. The ore mined is generally porphyry. Overburden is highly silicious, composed of silicified limestone and quartzite.

MORE TONS PER DOLLAR

Read these user reports on how AMSCO Dippers and Teeth perform in rugged digging service

ON THE NIAGARA POWER PROJECT

40,000 YARDS OF ROCK HANDLED BEFORE AMSCO 2-PART TEETH NEED REPLACING

Gull & Defelice Construction Co. is working on Section 3 of the powerhouse conduit project – excavating 140 feet deep, almost entirely in rock. All five power shovel dippers on the job are now equipped with Amsco Simplex 2-Part Reversible Teeth.

These dippers work *16 hours a day, 6 days a week for 2 weeks—handle approximately 40,000 yards of rock*—before tooth replacement is required.

Says Mike Cazzolla, Equipment Superintendent, in talking about the Amsco teeth: "They're built rugged and take a lot of punishment from the rock. We get longer wear out of them because we can turn them over." He's referring, of course, to the reversible tip feature.

John Cazzolla, Master Mechanic, adds the important fact that *they can replace these teeth in ten minutes with no trouble.* This feature, together with the longer wear, means important savings in downtime.

AT ONE OF WORLD'S LARGEST COPPER MINES

THEY USE AMSCO DIPPERS ...FOR HIGH-SHOCK, HIGHLY ABRASIVE DIGGING

This huge copper mine operates the largest collection of big power shovels (5 yards and up) in the world. For this rugged service they use Amsco dippers to strip off extremely abrasive overburden ... handle waste material ... and load copper ore. These are cast manganese steel dippers – built for toughness, high abrasion resistance and long service life.

For rugged digging anywhere

... wherever high impact and abrasion are problems, you'll "move more tons per dollar" with Amsco Manganese Steel Dippers and Simplex 2-Part Reversible Teeth. See your power shovel equipment dealer for sizes and types available. Or write us direct for technical bulletins on Amsco Dippers and Simplex 2-Part Teeth.

AMERICAN Brake Shoe COMPANY

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

Other Plants In: Denver • Los Angeles • New Castle, Dela. • Oakland, California • St. Louis
In Canada: Joliette Steel and Manitoba Steel Foundry Divisions

JOB RECORDS PROVE

Firestones keep tire costs down!

Count on Firestones to reduce your hourly costs—no matter where you work 'em! Every Firestone is job-engineered to match the punishment of the toughest jobs. They're built with Firestone Rubber-X, the longest-wearing rubber ever used in Firestone tires! Exclusive Firestone S/F (Shock-Fortified) nylon or rayon bodies shrug off bruising shock and impact. Specially designed Firestone treads and sidewalls roll through conditions that often ruin ordinary tires. Call your Firestone Dealer or Store and ask about the full line of Firestone tubeless or tubed off-the-highway tires. He'll recommend the tires that are built for your job! And, remember, Firestone off-the-highway tires are backed with on-the-job service!

Rock Grip Excavator Wide Base

Rock Grip Excavator

When ordering new equipment always specify Firestone tires—available tubeless or tubed.

Firestone

BETTER RUBBER FROM START TO FINISH

Copyright 1959, The Firestone Tire & Rubber Company

NEW SLANT IN TRACTOR SHOVELS

NEW BENEFITS for YOU

- **40° bucket tip-back**
- **Fast reverse to 4.1 mph**
- **Important operator advantages**
- **New "down-slope" visibility**
- **Best reach, best dump height in its class**

GIVES YOU EXTRA DUMP
. . . LOA

- **72 net engine hp**
- **21,000 lb**
- **1½ cu yd general purpose bucket**

MP **HEIGHT** WITH A BONUS IN **REACH**
OADS BIGGEST TRUCKS EASILY

With as much as a foot more dumping height than the maximum for ordinary tractor shovels, the 6G reaches 'way out at any height to dump over the center of big, side-boarded, 12-yd trucks . . . places each bucketful just where you want it. This height-and-reach combination pays off other ways, too—building stockpiles or loading out over the sides of excavations.

AND THAT'S ONLY THE BEGINNING . . .

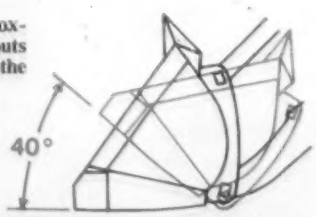
HERE'S EVERYTHING YOU NEED FOR

BIG PRODUCTION

BREAKOUT

action of the new 6G puts a 10¼-ton force at the cutting edge as the heavy-duty bucket tips back 40° on its curved bottom. This tremendous pry-out is far more effective than the fixed leverage of an ordinary, shoe-type bucket bottom. The 6G easily digs, lifts and loads stubborn boulders, stumps, pavement slabs or any hard-packed material with effortless speed—gets *more* digging-loading work done *faster* than any tractor shovel near this size.

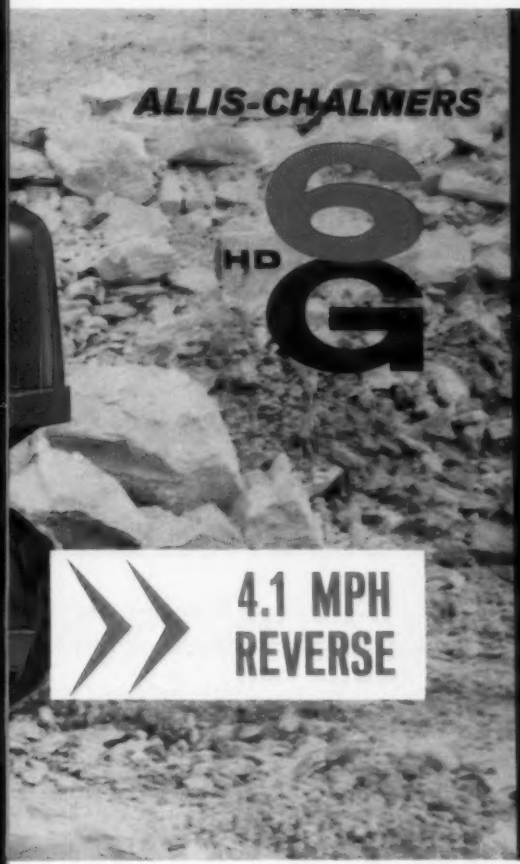
40° tip-back on curved, box-section bottom of bucket puts 21,500-lb breakout force at the cutting edge.

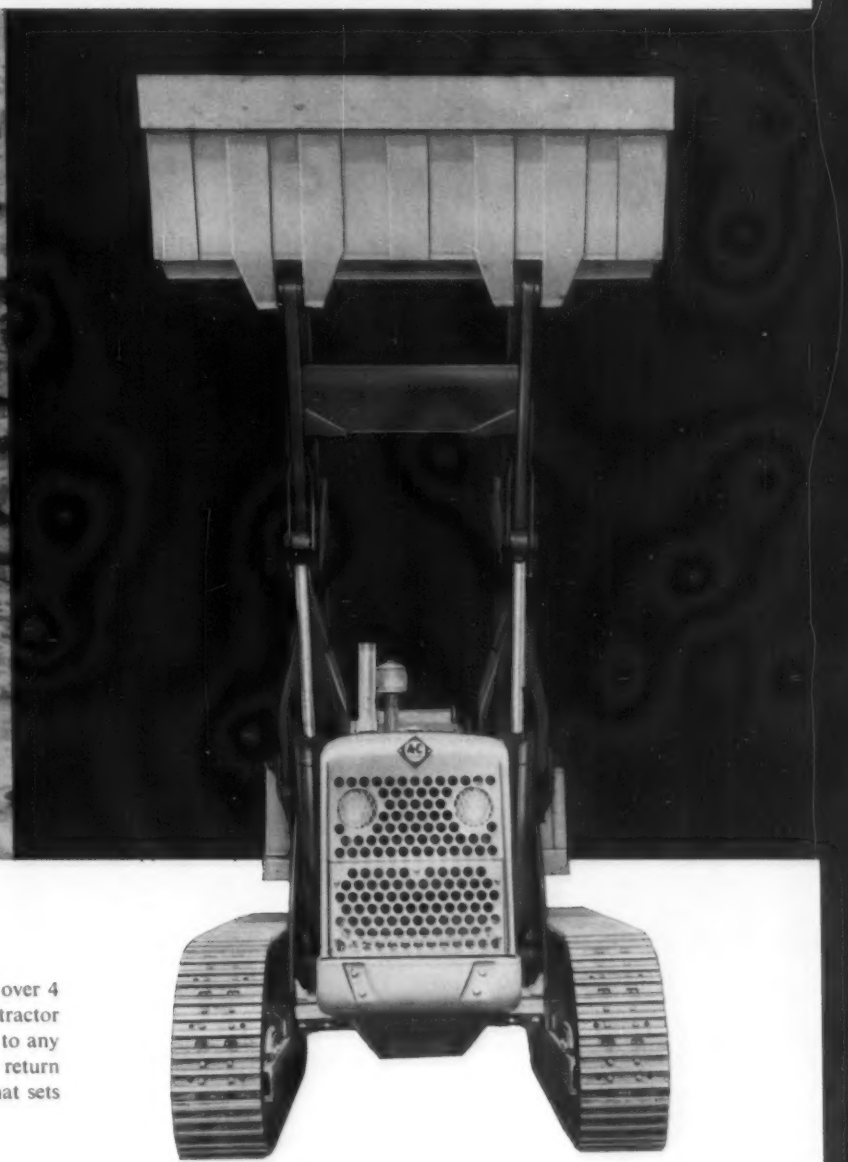


BALANCE

of the new 6G is outstanding, with nearly seven feet of track on the ground to distribute tractor and load weight for safe handling at big-production speeds. Engineered and built from track to stack as a tractor shovel—not just a tractor with a bucket—the 6G has stability and strength to lift heaviest loads safely and surely, right to the top without wobble or wasteful spilling. Dependable, heavy-duty hydraulics provide the precise control necessary to hold finish grades.

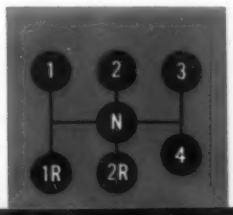
. . . AT LOW COST





SPEED

. . . the new 6G can back away with a load at over 4 mph! You choose the *right speed* for every tractor shovel function—shift briskly from high reverse to any forward speed with a single lever. Bucket lift and return is perfectly controlled—a smooth, swift cycle that sets a fast pace on any job.



STRENGTH

. . . "In-Line" booms and linkage are twin towers of solid-steel strength in the new 6G. They're straddle-mounted on wide-spaced pivots in the shovel side frames for no-sway stability in all positions. Lift and dump cylinders operate in exactly the same line, put the 6G's hydraulic power to work "straight from the shoulder."

ALLIS-CHALMERS HD 6G

New Operating ease and service simplicity mean extra production . . . long life

Roomy Comfort. Deck-level entrance gangway . . . nine-position, foam-padded seat . . . easy-to-reach controls . . . plenty of leg room.

Clean-Sweep Visibility. Down-sloping, tapered cowl and hood . . . clear view of bucket . . . slim fuel tank, stub fenders for rearward vision.

"Extras" are Standard Equipment. Push-button starter on instrument panel . . . decelerator pedal . . . automatic bucket level indicator.

Certified Permanent Lubrication. Heavy-duty, tapered roller bearing truck wheels, idlers, support rollers never need greasing. *True* unit construction lets you remove and replace any major part without disturbing adjacent assemblies. *Both these features exclusive* in this size tractor shovel.

For Extra Return on Your Investment... Quick-Change Attachments

The 6G's 1½-yd general purpose bucket is ideal for most digging, handling and loading jobs. Add bucket teeth and rear-mounted hydraulic ripper and you've got a machine that's built for business at *both* ends in extra-tough work. Interchangeable front-end attachments mount in minutes, quickly adapt your tractor shovel to do special jobs faster and at lower cost.

Count on your Allis-Chalmers dealer for operating advice, maintenance suggestions and 'round-the-clock service—when and where you need it. He'll help you get top performance and long life from your 6G or any other Allis-Chalmers machine you own . . . with genuine, factory-quality, regular production parts—made for the machine, best for the job. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

move ahead with

ALLIS-CHALMERS

...power for a growing world

FALK Motoreducers driving log conveyor and refuse conveyor at the modern mill of The Bohemia Lumber Company, Culp Creek, Oregon.

FALK *all-steel* Motoreducers give you longer service life

Whether your load conditions are normal or heavy, the extra rigidity of all-steel construction (more than twice that of cast iron) maintains better alignment of revolving elements under load...a vital factor in prolonging the service life of gears and bearings.

And if your installations are subject to shock loads, or accidental external impacts, you're way ahead when you install Falk All-Steel Motoreducers. These rugged units do not destroy themselves by tearing off their feet under jamming overloads, nor are their housings subject to cracks which both dissipate the vital lubricant supply and allow revolving elements to get out of alignment.

All-steel construction is one of the built-in extras that you get in Falk Motoreducers. Others include: (1) 12 to 15% reserve load-carrying capacity in the gears (by AGMA standards), thanks to exclusive Falk extra-depth, high pressure angle helical gears; (2) maximum mechanical efficiency (98½% per gear mesh, under full load); (3) your choice of standard units (horizontal, vertical or right angle) to fit your precise requirements.

HORSEPOWER RANGE: to 75 hp . . . STANDARD OUTPUT SPEEDS: 780 rpm (high) to 1.2 rpm (low).

Prompt delivery from distributor stocks, or from warehouse or factory. Ask your Falk Representative or Authorized Falk Distributor for ***Bulletin 3100.***

THE FALK CORPORATION, MILWAUKEE 1, WIS.

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

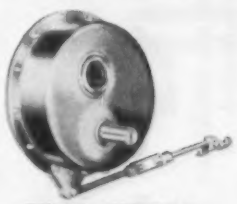
Representatives and Distributors in most principal cities

FALK

. . . a good name in industry

Take your choice of all-steel drives when you specify Falk

THE FALK ALL-MOTOR MOTOREDUCER
...the original All-Motor unit



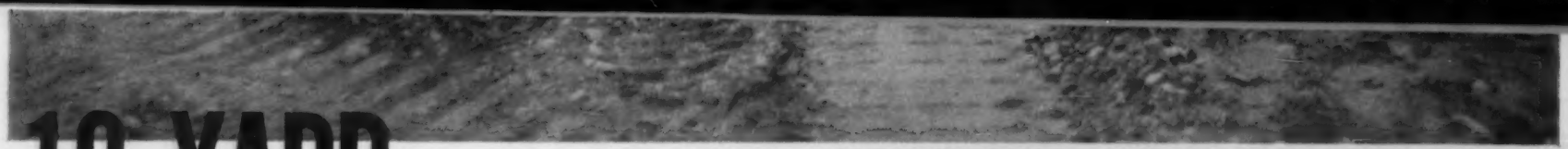
THE ALL-STEEL FALK SHAFT MOUNTED DRIVE

Torque ratings to 41,000 lb-in at low speed shaft. Also available in flange-mount design.

FALK and ALL-MOTOR are Registered Trademarks.

NOW... there are 2 Koehring® Dumptors

◀ Big wide-flared body of the model 100 Dumptor makes an easy target for the sensational new Koehring 205 Skooper. From a "stand-still" position, Skooper makes 5 fast passes with 2-yard bucket, and Dumptor is fully loaded. The full-revolving loader does big bucket digging and loading without the usual drive-in back-out waste motion — and without the high maintenance of skid-turn operation. Skooper's complete digging and loading cycle is: crowd, hoist, swing and dump — then back to digging position — with no traveling.



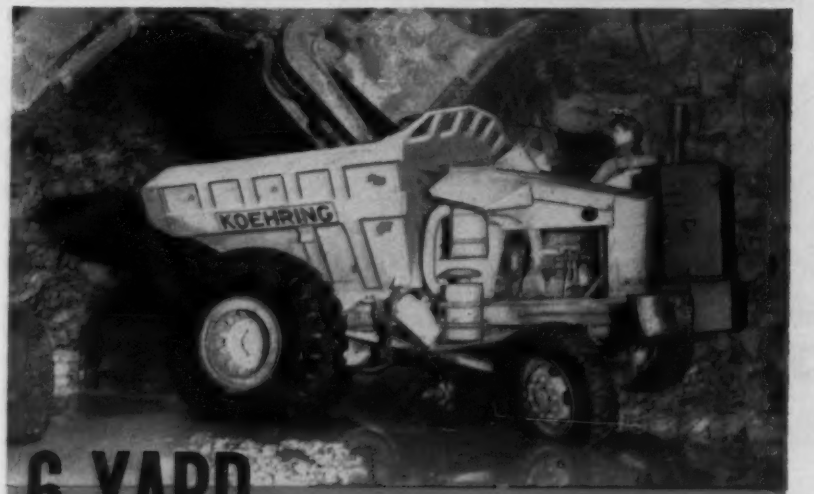
10-YARD . . .

with 2-way controls . . . pivoting seat . . . 20.8 mph speeds in both directions for fast, no-turn shuttle-hauling

Take another look at the big model 100 Dumptor® shown above. A recent addition to the Koehring line, this heavy-duty off-road hauler combines 30,000-lb. payload capacity, no-turn hauling, unique two-way controls and fast dumping action for moving big tonnages in open pits, or in underground mines. There's no need to turn at the loader, on the haul, or at the dump area, because Dumptor operates with equal ease in either direction. Operator always faces direction of travel — swings around *without leaving seat.* Dual steering wheels, throttle, brake pedals are located at *both* operating positions of *pivoting seat.* Directional travel and speed-range lever, and dump controls, are centrally located for 2-way operation. Constant-mesh transmission with smooth torque-converter drive gives speeds up to 20.8 m.p.h. in both directions. High or low speed range controlled by easy-acting hydraulic clutches.

10-yard Dumptor hauls up 28½% grades fully loaded—has power steering — big, safe, 4-wheel airbrakes, plus parking brake. And that's not all — there are two ways to dump — *instantaneous* gravity — or *controlled* gravity with hydraulic cylinders. Get the complete story from your Koehring distributor, or write us today.

KOEHRING
DIVISION OF KOEHRING COMPANY
Milwaukee 16, Wisconsin



6-YARD . . .

Companion-model 60 Dumptor also offers cost-cutting advantages for your heavy-duty hauling. Smaller in size, but just as rugged as the larger Dumptor, this 6-yard has a ton of strength for every ton of payload capacity. There's better than 6 H.P. for every ton of loaded weight. It accelerates fast — climbs 23% ramps or grades fully loaded. Heavy-duty, constant-mesh transmission gives same 3-speed travel in both directions. No need to turn. Gravity dumping action is simple, trouble-free. Get all these advantages on your work — haul with Dumptors.

Mail to: KOEHRING Division, 3026 W. Concordia, Milwaukee 16, Wisconsin

Please send literature on: ■ 10-yard Dumptor ■ 6-yard Dumptor ■ Skooper

NAME _____ TITLE _____

COMPANY _____ DIV. _____

STREET _____

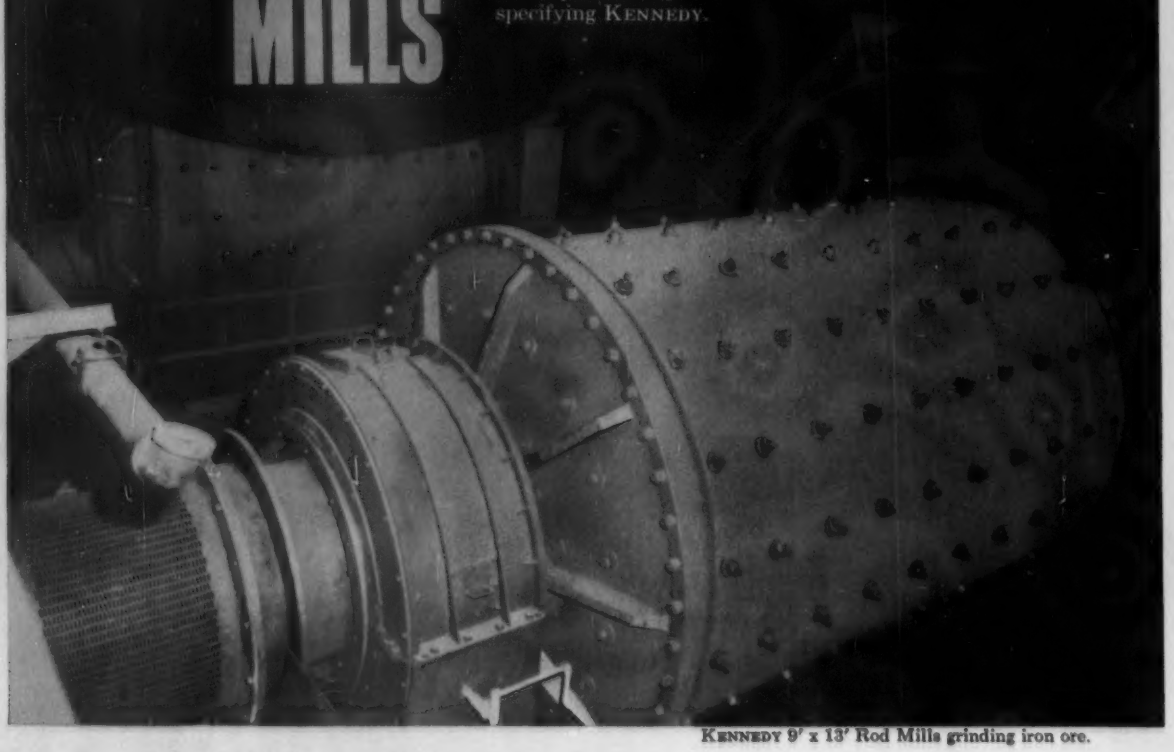
CITY _____ STATE _____

KENNEDY ROD MILLS

for the Mining Industry

Dependable operation in wet or dry grinding of material at low cost, with minimum maintenance—this is the reputation that KENNEDY Rod Mills enjoy.

You can profit from this reputation by specifying KENNEDY.



KENNEDY 9' x 13' Rod Mills grinding iron ore.

features that distinguish

KENNEDY GRINDING MILLS

- Cast steel or Meehanite heads
- Welded and stress-relieved heavy steel plate shells
- Large diameter trunnions
- Self-aligning bearings with adjustable sole plates
- Positive "Ferris Wheel" lubrication of main bearings
- Oil-tight bearing seals
- Motorized hydraulic lift to reduce starting torque
- Single helical cast steel gear and pinion

Send for complete information on KENNEDY equipment.

Primary & Secondary Gyratory Crushers—Jaw Crushers—Roll Crushers—Ball Mills—Rod Mills—Air Swept Mills—Impact Breakers—Hammer Mills—Belt Conveyors—Feeders—Vibrating Screens—KENNEDY Research and Testing Services.

KVS

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MANUFACTURING & ENGINEERING CORPORATION

405 PARK AVENUE, NEW YORK 22, N. Y. • FACTORY: DANVILLE, PA.

ONE RESPIRATOR STANDS OUT

Make your next move a big one!

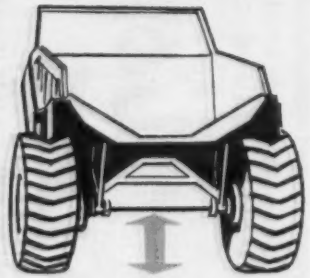
With an Allis-Chalmers TR-260 rear dump

...you get that extra measure of power and capacity—to speed the toughest hauling jobs. This 230-hp rear-dump haul unit moves 20-ton loads at speeds up to 28 mph . . . outworks and outproduces conventional haulers around mines and quarries.

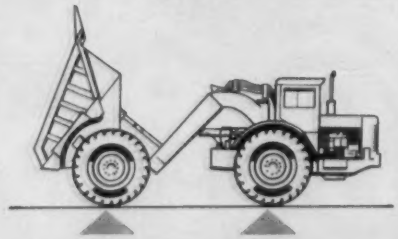
You'll find it easy to move with a TR-260. It often saves time and money by moving over adverse terrain to cut hauling cycles in half. Watch this unit at work . . . be convinced that your next big move should be with an Allis-Chalmers TR-260.

Two TR-260 rock wagons (part of a team of six units on the job) speed 20-ton loads up steep grades and over rough terrain. Big, low-pressure tires "float" machines over all obstacles . . . help make handling these giants a pleasure.

Can your haulers match these big TR-260 advantages?



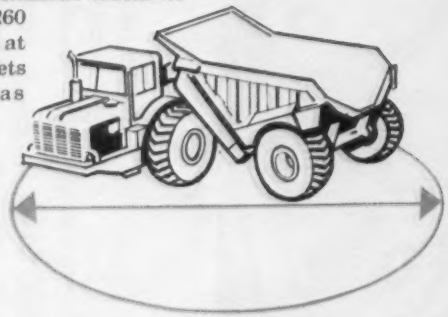
High ground clearance—25¾-in. wagon clearance lets the TR-260 roll over high spots without hanging up . . . move through softest footing without bogging down. KON-TORK differential automatically controls torque to each drive wheel . . . keeps the TR-260 moving in all kinds of conditions.

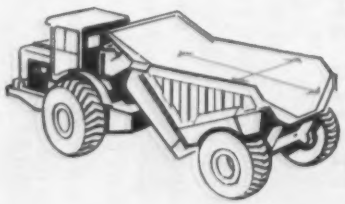


Safe, sure dumping—The TR-260 dumps with all four wheels braked . . . no need to back up tractor to get loads out. On the getaway, power is on the forward wheels where footing is solid.

KON-TORK is an Allis-Chalmers trademark.

Short turning radius—24 ft, 9 in. is all it takes for a complete turn with the TR-260. That's a lot less turning space than conventional trucks require. That's why the TR-260 spots faster under shovels and at hoppers . . . that's why it gets away from congested areas quicker than most haulers.





Easy loading—Big 11-ft, 2½-in. x 8-ft target area makes loading a snap with all types of overhead loaders. Low rear entry reduces height that shovel has to be raised. Front body extension protects operator's cab and steering jacks.

Interchangeability Reduces Equipment Investment—You can get double value from your TR-260 rear-dump unit. It interchanges with the TS-260 motor scraper. Both units match the same tractor . . . and can be interchanged in a few hours. The TS-260 is a high-production earth mover; the TR-260, a rugged hauler of overhead loaded materials.

Your Allis-Chalmers dealer can show you how these powerful, high-speed units can bring you extra profit insurance the year 'round—whether handling dirt or rock. Allis-Chalmers Construction Machinery Division, Milwaukee 1, Wisconsin.

move ahead with ALLIS-CHALMERS . . . power for a growing world

NOW FROM FORD
America's lowest-priced 4-wheel drive pickups
Six or V-8!

New Ford F-100 4-wheel drive Styleside pickup handles heavy loads and makes its own road.

ALL FORD-BUILT . . . FACTORY-ENGINEERED . . . FOR GREATER SAVINGS!

Go *Ford*-ward for 4-wheel drive performance at big Ford savings. New Ford 4 x 4 Pickups have the power and traction to go most anywhere. They're factory-engineered from the ground up for extra stamina, and all Ford-built with your choice of economical Short Stroke power—Six or V-8.

There's new versatility too, with two power take-off points in the transfer case to drive winches, saws, diggers, or other equipment. And there's new driving ease. You shift smoothly between 2- and 4-wheel direct drives while moving. Ford's *driverized* cab provides new riding comfort and modern styling.

Ford 4-wheel drive trucks are available in ½- and ¾-ton pickups, chassis-cabs and ¾-ton stake models. See your Ford Dealer . . . and save hundreds of dollars on America's lowest-priced 4 x 4's with Six or V-8 engine!

FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . LAST LONGER, TOO!

for rock or ore

NEW 66"

TELSMITH® Gyrasphere®

MEETS ALL DEMANDS with

1. *Higher Capacity*
2. *Lower Power Needs*
3. *Lowest Upkeep*

New 66" Telsmith FC Fine Crushing Gyrasphere with grooved pulley suitable for V-rope drive and with oil tank, oil piping and separate oil pump and motor are standard equipment on the new 66" Gyrasphere.

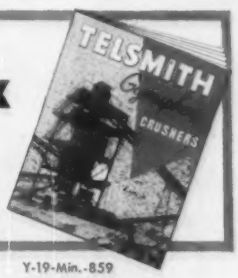
● The new No. 66 Gyrasphere combines all the big production, low-cost operation and maintenance features of other Telsmith Gyraspheres—plus new, simple and easy, hydraulic adjustment of discharge opening. Our new Bulletin No. 274 explains all of the outstanding features of the new No. 66 and gives complete information, including new capacity tables, on all sizes of Telsmith Gyraspheres. These are the Secondary Crushers which will give you *the lowest cost per ton.*

TELSMITH GYRASPHERES NOW made in FOUR SIZES— 24", 36", 48", and the NEW 66" ...for Coarse and Fine Crushing

Get this NEW BOOK

it's your guide to more profit

Ask for No. 274



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SMITH ENGINEERING WORKS

502 E. CAPITOL DRIVE • **MILWAUKEE 1, WISCONSIN**

Representatives in Principal Cities in All Parts of the World • Cable Address: Songworks, Milwaukee

Stays on the Job. Amerclad Shovel Cable has a record of long service life that keeps expensive equipment working.

(*Right*) **Designed for Rugged Work.** Amerclad Mining Machine Cables are unsurpassed for resistance to abrasion, acid mine water, oil and grease.

(*Far Right*) **Built-in Quality.** Amerclad's consistent high quality is maintained by modern precision equipment like the continuous lead press.

USS

Tiger Brand Electrical Wire & Cable

A standard cable for every special job

- Asbestos Wire and Cable
- Mold-Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

What's the difference in electrical cable?

USS Tiger Brand Amerclad has built-in ruggedness

Of all the equipment on your job, none gets more grueling treatment than portable power cable. You drag it over sharp rocks, soak it in acid mine water, crush it, scrape it and bend it.

Tiger Brand Amerclad Cables are jacketed with flame-resistant Amerprene, a tough, hard-wearing compound that withstands oil, abrasion and constant exposure to sun, snow and rain.

One of the factors that contributes to long trouble-free life is the dynamically balanced rope lay conductors. Concentric stranded wire of the ideal size—as opposed to loosely bunched groups of fine wires—are carefully prestressed to give balanced performance and freedom from unequal elongation between conductors.

Another important factor in twin parallel cables is our "Bridgewall" construction, which actually puts a bridgewall of live Amerprene between the two insulated conductors and is an integral part of the jacket.

The same standards for materials and manufacturing practices to which the largest Amerclad shovel and power cables are built, govern the manufacture of the smallest Amerclad portable cords.

These are a few of the unseen plus values you get when you buy Tiger Brand Cables for your shovels, welders, continuous miners, drills, shuttle cars, portable tools, and other equipment. For complete technical information, write for our free book, "Tiger Brand Amerclad Cord and Cable," American Steel & Wire, Dept. 9266, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

USS, Amerclad and Tiger Brand are registered trademarks

American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
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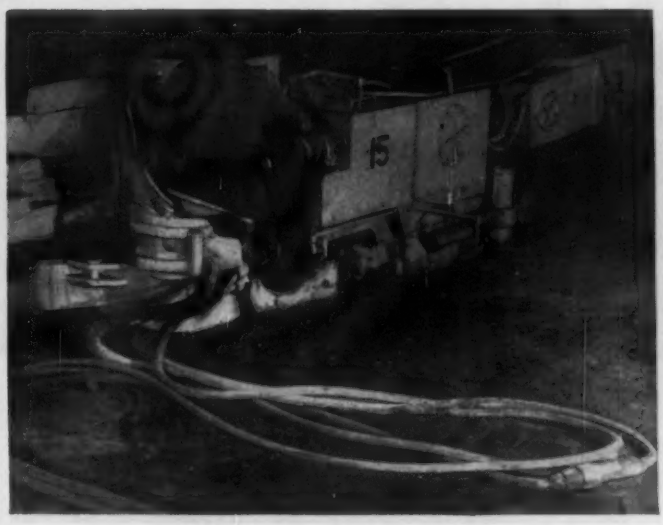
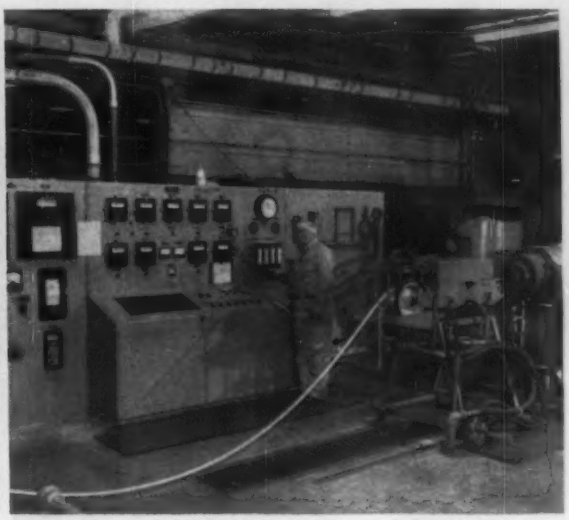




HARBISON-WALKER

anticipates the refractories needs of the expanding aluminum industry

Within the last couple of decades the production of aluminum metal in the United States has trebled and the number of its alloys has increased manyfold. Rapid evolutionary developments created the need for refractories to meet new conditions. The severity of corrosion, more destructive impact accompanying furnace charging and the necessity of avoiding contaminants in order to meet rigid alloy specifications—these among other factors have become increasingly important.

Since the first commercial production of aluminum and its alloys, Harbison-Walker brands, primarily of alumina-silica and high-alumina compositions, have continued to fulfill the ever-growing demands. Through unceasing research several refractories, recently developed specifically for aluminum melting furnaces, possess definitely superior properties for maximum durability and best quality of metal. Harbison-Walker's CORALITE XX (85% alumina brick) has established excellent service records in aluminum furnace bottoms and side walls. Several modifications with enhanced properties now are in commercial production. These unique refractories especially suited for aluminum melting furnaces are here briefly described.

Coralite 22-58
Coralite 3-59
CORALBOND

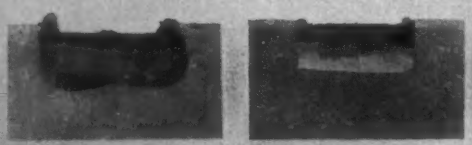
CORALITE 22-58 is a stabilized aluminum phosphate-bonded brick containing approximately 85% alumina. It has exceedingly high strength and withstands greater impact and abrasion. Its resistance to wetting and penetration by the molten metal are properties of paramount importance. CORALITE 24-59 is the hard-fired variation, having still higher mechanical strength.

CORALITE 3-59 is a very hard-burned brick containing approximately 85% alumina. It is made with a special bond (patent pending) which contributes to its remarkable strength. It is very resistant to penetration and reaction with molten aluminum.

CORALBOND is a phosphate bonded high alumina mortar developed specifically for use in aluminum melting furnaces. It is very outstanding in its resistance to penetration and corrosion by aluminum alloys at the furnace operating temperatures.

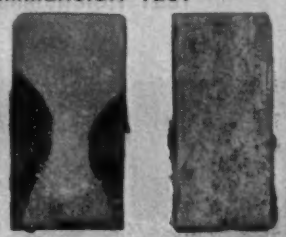
Laboratory tests illustrate superior properties

CUP TEST



Photograph of accelerated cup test with molten aluminum alloy—at 1700°F for 30 hours—showing relative degree of penetration between normal high alumina brick on the left and CORALITE 22-58 on the right.

IMMERSION TEST



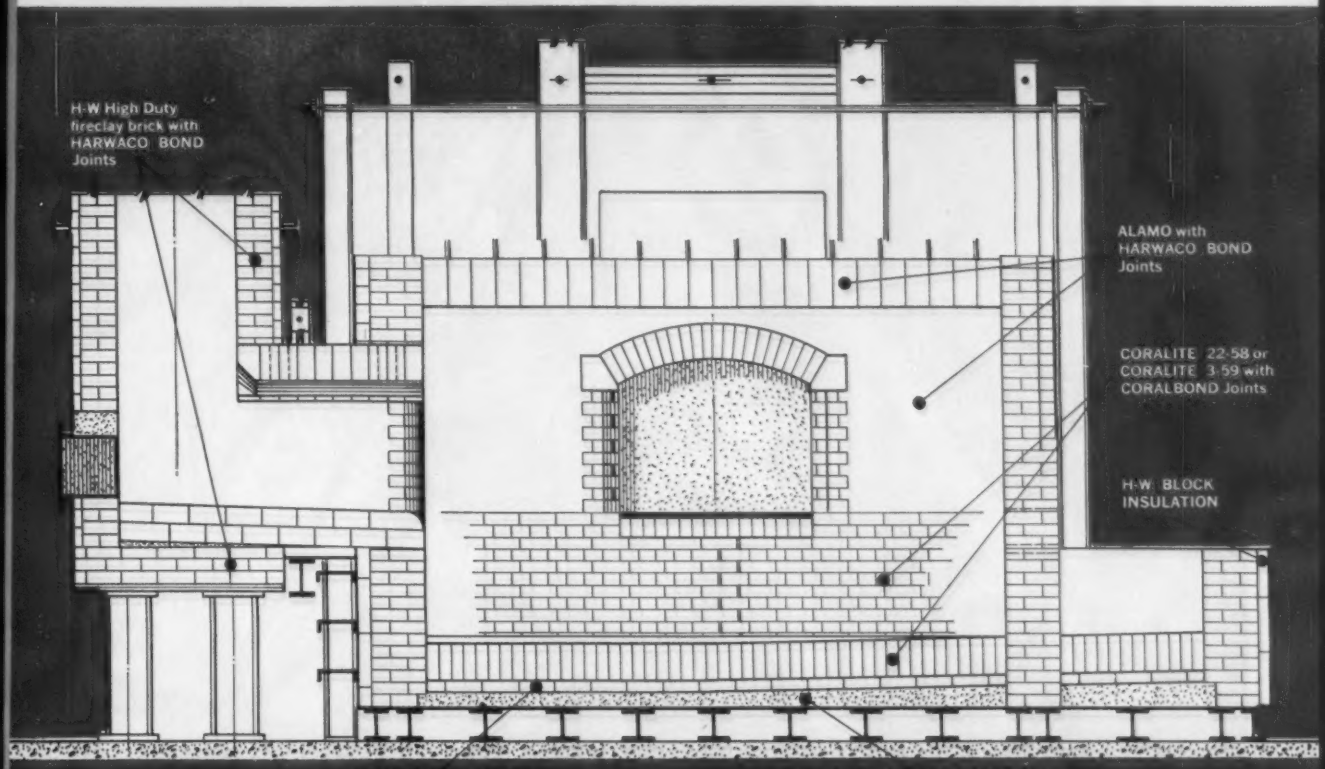
These brick, which were immersed in aluminum alloy at 1400°F for nine days, show contrast in degree of penetration or wetting between a normal high alumina brick, left, and CORALITE 3-59, on the right.

Harbison-Walker

World's Most Complete Refractories Service

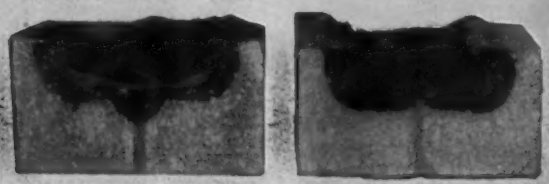
GENERAL OFFICES *PITTSBURGH 22, PA.*

RESEARCH


H-W High Duty fireclay brick with HARWACO BOND Joints
ALAMO with HARWACO BOND Joints
CORALITE 22-58 or CORALITE 3-59 with CORALBOND Joints
H-W BLOCK INSULATION
ANCHOR (60% Al_2O_3)
H-W EXTRA STRENGTH CASTABLE

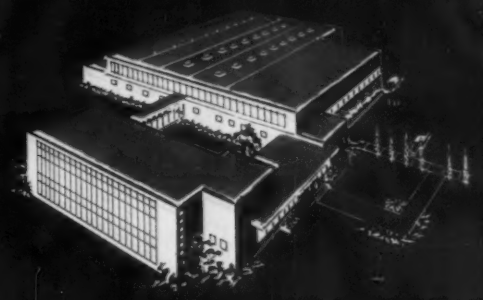
Schematic drawing of an aluminum melting furnace

MORTAR JOINT TEST



Photograph of Laboratory "cup tests" with molten aluminum alloy, show striking difference in resistance to penetration and corrosion between a widely-used air-setting bonding mortar at the left and the CORALBOND joint at the right. Among many mortars of widely different compositions, CORALBOND—as illustrated in this test—is unmatched.

Leadership in Refractories Through Constant Research



GARBER RESEARCH CENTER

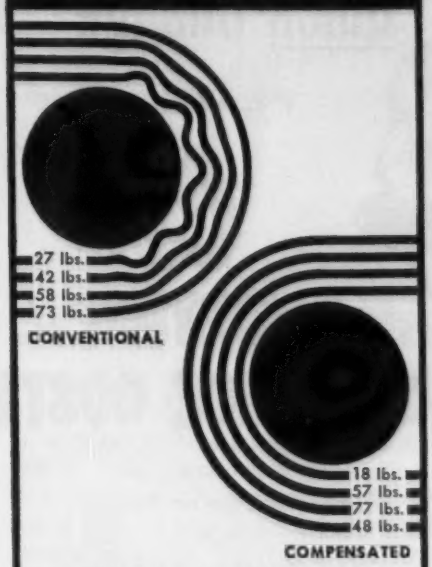
Refractories Company
AND SUBSIDIARIES

RAY-MAN CONVEYOR BELT
Lasts Longer on Tough Hauls

R/M engineering makes the difference with Ray-Man Conveyor Belt. Cushioned strength members give it the resiliency to take the impact of shock loading . . . the flexibility to train better, trough naturally. Balanced *Double*-Compensation relieves outer ply stresses, prolongs belt life under the most rugged operating conditions. R/M's exclusive "XDC" Cover gives Ray-Man extra protection against wear, tear, cuts and abrasion never before possible.

Ray-Man Conveyor Belt is rip resistant. It requires no breaker strip . . . holds fasteners far better than other constructions. Like all R/M heavy duty conveyor belts, Ray-Man is both moisture resistant and mildew-proof. Let an R/M representative show you the engineered advantages of Ray-Man Conveyor Belt and other R/M constructions . . . extra-cushioned Homocord for unusually severe shock loading . . . R/M Tension-Master for extra long lifts, high tensions. Write for Bulletin M302.

STRESS-RELIEF OF OUTER PLIES MEANS LONGER BELT LIFE . . . "More Use per Dollar"



CONTROLLED PLY ELASTICITY

Note how Double-Compensation at right equalizes ply stresses.

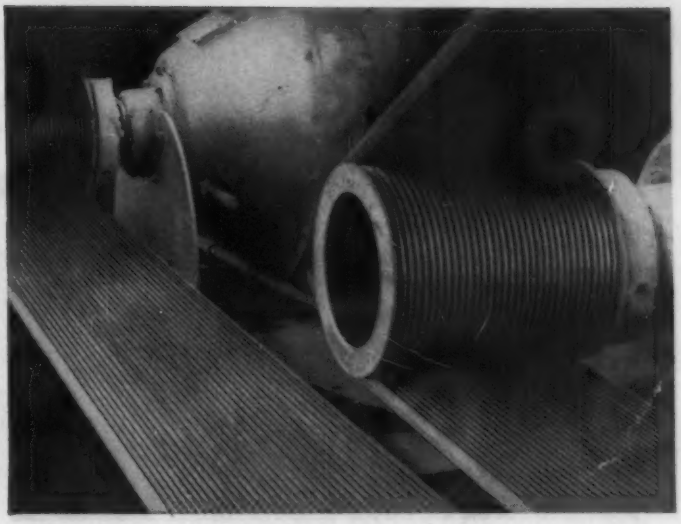
1. Center plies on neutral axis and better protected carry more load.
2. Outer plies stress-relieved by adjusting to tension and compression.

INDUSTRY'S *ONLY* COMPENSATED BELT

Ray-Man Compensation relieves outer ply stress . . . allows outside ply to elongate more than inner plies as the belt flexes around the pulleys. Inner plies no longer "loaf", but carry full share of the load.

Outer ply is better able to absorb strain and impact of loading, pull as a strength member, *protect* the inner plies, hold fasteners or splice longer.

And, because Ray-Man is *double Compensated*—both top and bottom plies stress-relieved—Ray-Man Compensation prolongs belt life, even where operated over reverse bend, snub or take-up pulleys!



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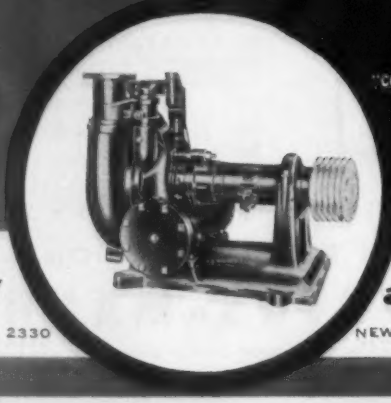

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ENGINEERING AND MINING JOURNAL

SEPTEMBER 1959

Who Owns the Sea?

One of our favorite grammar-school essays was entitled, "Who Owns the Mountains?" A little boy asked the question as he trudged beside his father on a hike through mountain country. In essence, the father replied that the mountains really belong to those who can see and enjoy their beauty.

From an aesthetic viewpoint the answer was enlightening, but it would never have satisfied the early gold prospector who had to establish a more tangible basis for the ownership of his claims. This was covered in the basic mining law of 1872 which even to this day determines in part "who owns the mountains".

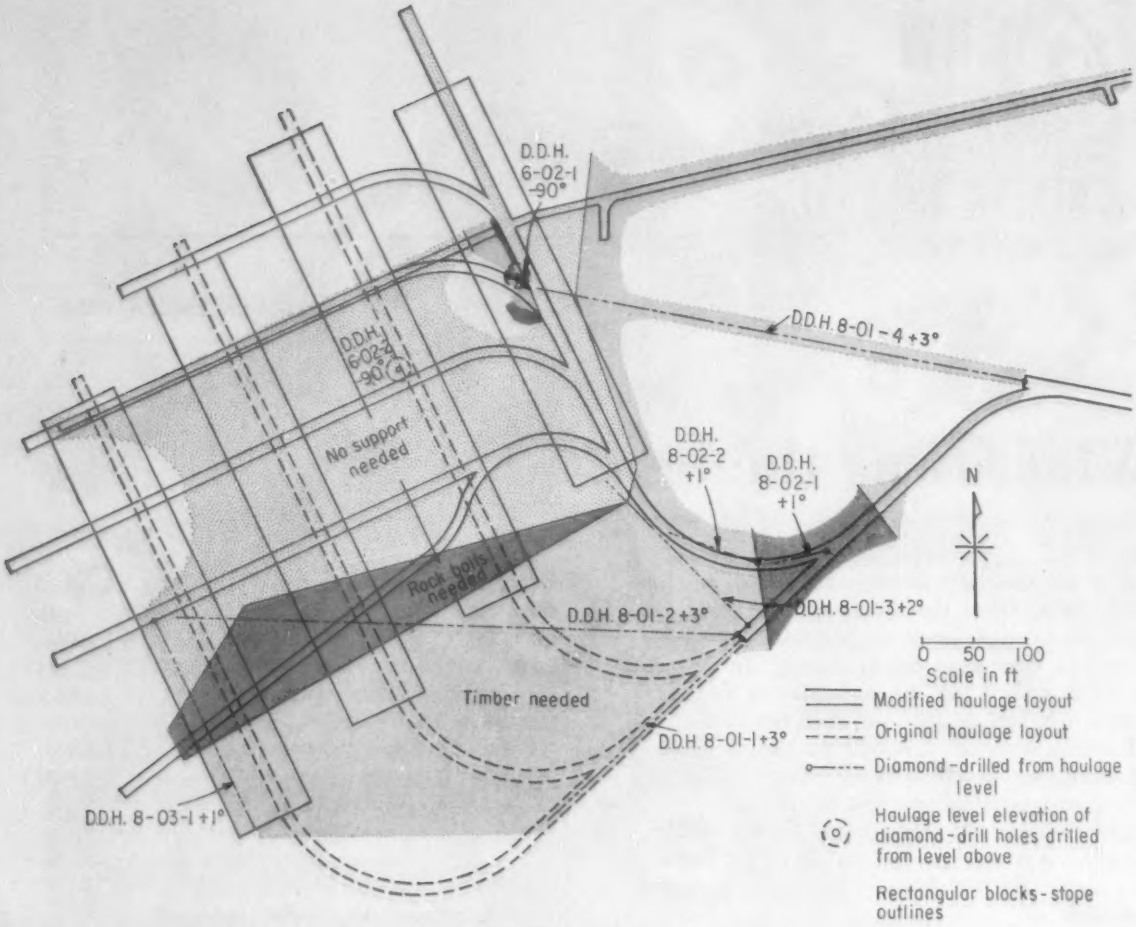
Recent oceanographic discoveries of mineral wealth in and beneath the sea may well prompt us to wonder, even as the little boy did, about "Who Owns the Sea?" How long, for instance, will we be able to live with current international laws concerning the sea in the face of knowledge that approximately 14.2-million sq miles of ocean floor contain economically mineable manganese deposits totaling some 200-billion tons of nodules averaging 0.50% each of nickel, copper and cobalt—enough to supply the world for hundreds of years to come. This fact and many other astonishing details were revealed in a paper on deep-sea mining by John L. Mero, graduate research engineer, University of California, given at Colorado Mining Association's conference in Denver last February.

Mero also said that the manganese dioxide occurred in the form of nodules, grains, coatings on rocks and impregnations in porous materials. Two feasible methods of mining include the suction dredge and the deep-sea drag-bucket dredge. Studies indicate that mining costs for a drag dredge would be about $5 per ton of recovered nodules at a depth of 1,000 ft, and $15 per ton at 5,000 ft. A remote-controlled suction dredge was described (E&MJ July 1959, p 209) which would deliver nodules through a 15-in. pipeline at a rate of 5,000 tons per day. Dredge costs would be about $2-million. Mining costs would be about $3 per ton at 5,000 ft and 15c per ton extra for each additional 1,000 ft.

One of the huge nodule deposits was discovered in the Blake Plateau, about 200 miles east of the U.S., by the Dawnwind Expedition in 1958.

We might speculate about what would happen if Russia or some other government quietly set up a sea platform in the Blake Plateau area and started to pump out rich manganese nodules on a large tonnage basis. Could the U.S. with the largest steel industry in the world, but decidely anemic manganese resources, afford to sit idly by without putting another dredge in the field? And if it did, how would the "claims be staked out?" As matters stand, it appears that whoever gets out first with the best equipment will establish incontestable mining "claim" rights. Production rather than location may thus determine who owns the mineral rights to the sea.

Related to this subject is the interesting concept of extracting minute concentrations of metals from seawater by new chemical-flotation processes. See p 183. Although it is too early to estimate the value of these processes, it does appear that in the future countries which border the sea, or which "mine" the sea, may change the economic mineral map of the world appreciably.



LOW COST of new haulage level resulted from modification of original layout to take advantage of self-supporting rock as predicted by analysis of certain diamond drill core data. Method is simple, using easily performed tests to get data.

How Cananea Uses Drill-Core Data To Aid Ground Control Planning

ARTHUR W. RUFF

LUTE J. PARKINSON

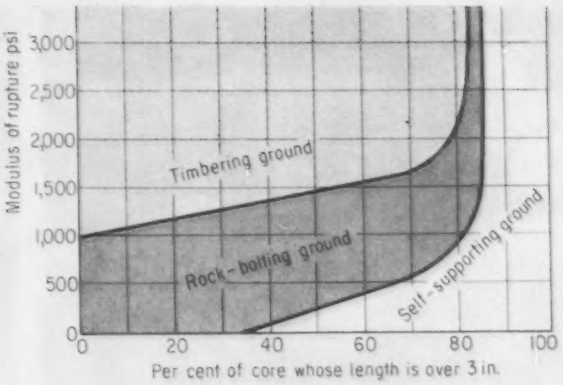
CORE-SEGMENT LENGTH AND MODULUS OF RUPTURE appear to be two criteria by which drill-core can be used to predict the ground support needed in a given mining area, according to the results of a joint investigation by Cananea Consolidated Copper Co. and Colorado School of Mines.

Dr. Ruff (left), author of this article, is assistant mine superintendent at Cananea Consolidated Copper Co., Cananea, Sonora, Mexico. Prof. Parkinson is head of the department of mining engineering at Colorado School of Mines, Golden, Colorado, and was closely associated with the study.

The investigation was started several years ago because of economics. The low mining cost currently maintained by Cananea is partially dependent upon the very little timber or concrete needed to support the underground excavations. So far, the rock has been strong and has not been unduly fractured. Unfortunately, it is evident that as mining progresses deeper the rock will be less competent and will need to be timbered or otherwise supported. To keep mining costs low, it is always desirable to drive production drifts in the stronger sections of the rock, providing this can be done without injury to the stoping layout. Therefore, a practical method of predicting the type of ground support needed in different areas has a very high economic value at Cananea.

Problem of Back Failure

If a flat-back drift is driven through a rock mass, the back may or may not fail depending principally on the strength of the rock itself, the fractures in the rock body, the superimposed stress, and the dimensions of the drift. Even if there are no



RUFF-PARKINSON METHOD of analysis is graphic, relating modulus of rupture and percent core over x in. long to the ground support needed. The graph at upper right shows a specific case for a flat-backed drift, 10x12 ft in size, in the test area at Cananea using 3-in. core-segments. Photos show the three typical conditions that were encountered.

abnormal stresses, most miners know that in weak ground the danger from roof collapse increases as the size of the opening increases, and that in weak or fractured ground the size of the opening must be smaller than in strong or non-fractured ground.

Usually, failure takes place by rock falling from the back until a dome is formed over the opening. Initial doming can take place with no abnormal super-imposed stress and only as a natural consequence of the force of gravity. Progressive doming causes the forces on the sides of the opening to resist more and more of the forces caused by gravity on the back of the opening. If final doming takes place, the stresses on the sides of the opening are then of sufficient magnitude to resist the force of gravity over the entire span of the back.

Many photoelastic analyses have been made for different types of openings and stress conditions. The data obtained describe many of the local stress areas around underground openings.[1] However, it is very difficult to apply the photoelastic results and to determine the type of ground support needed for a rock which has certain known physical characteristics.

Physical measurements of stress in place and of rock characteristics in place have not yet been sufficiently studied to permit planning the required support prior to excavation.

The Cananea investigation was aimed specifically at finding a way to predict, through observation or readily performed tests of drill core, whether or not gravity-type dome failure would occur if haulage drifts 10-ft wide and 12-ft high were driven in future mining areas which had been previously diamond drilled. The work was confined to an area where there were no visible indications of superimposed stress other than local gravity effects. However, the results indicate that the method should be adaptable to areas where superimposed stresses do prevail.

Procedure Was Simple

The procedure for the study was as follows:

1. Two horizontal EX diamond drill holes were drilled along the line of a proposed haulage drift to get a reasonably complete core.
2. From the core, data was secured at various intervals to include: length of sample, distance from hole collar, percent core recovery, percent of core over 3 in. long, and modulus of rupture for representative samples. Core recovery was considered an indication of overall rock competency; percent over 3 in., an indication of the number of fractures; and modulus of rupture, an indication of rock strength.
3. A 10-x 12-ft drift was driven along the holes and timber and rock-bolts used as needed according to operating experience criteria (see photos above).

Several parts of the procedure should be noted:

1. Samples should be taken at evident rock changes, for example, when there is a change in length of the pieces of core or an obvious change in rock strength.
2. The short section of crushed and broken rock which is usually found at the end of each drill run should not be considered when obtaining the per cent of core whose length is over 3 in. The crushed portion of core is a "core block" and may be produced intentionally to prevent the core from sliding from the core barrel when the drill rods are pulled. However, the "core blocks" should be considered when locating the samples.

Another point of interest is a very

SIMPLE APPARATUS used to determine modulus of rupture consisted of: balance arm 84 in. long, specimen holder and pail. Specimen was placed on holder and water run into pail until core broke. Depth of water was measured with metal tape welded to inside of pail. Water depth was converted into pounds of stress on the specimen. Rate of loading was about 325 lbs per minute. Diameters of specimens were measured to nearest 0.001 in. Specimen support bars were placed 2½ in. apart.

fast-acting, but simple, modulus of rupture testing machine which was made by W. R. Edmondson, mine master mechanic at Cananea (see photos above).

Once the data was at hand, an attempt was made to correlate the core data with the ground support data. Each variable was plotted against the depth of hole (see graphs). In comparing these graphs, it was found that high core recovery could be obtained both in rock which was self-supporting and in rock which needed support. Furthermore, even if the rock had a high modulus of rupture it still needed support wherever there was only a low percent of core over 3 in. long. On the other hand, rock with a low modulus of rupture and a low percent of core over 3 in. often needed no support.

From this it was concluded that the percent of core over 3 in. was an indication of the number of fractures only when the rock strength was also considered. Rock which had a low modulus of rupture would break in the core barrel and thereby produce a low percent of core over 3 in.; however, the rock was self-supporting because in reality it had few inherent fractures.

Analysis Yields Results

The modulus of rupture, the percent of core over 3 in., and the conditions encountered in the drift were then used to construct a useful graph (see previous page). In effect the plot relates the fractures and the strength of the rock to the necessary ground support. It shows that a medium-fractured, weak rock will have a lower percent of core over 3 in. than a medium-fractured, strong rock (the weak rock will break in the core barrel) but the weak rock may still stand unsupported. A strong rock which has a low percent of core over 3 in. will need some type of support since the rock will have inherent fractures.

At first glance, the graph suggests a discrepancy in the data. For example, a rock is self-supporting if 60 per cent of its core is composed of pieces over 3 in. long and if the rock has a modulus of rupture of 200 psi. If the rock has a modulus of rupture of 2,500 psi and only 60 per cent of the core is over 3 in. long, the rock needs timber support. Superficially it appears that more support is needed in strong than in weak ground. But this interpretation is contrary to common sense and is only true if the per cent of core whose length is over 3 in. is constant for both rocks. The correct interpretation is that as the strength of the rock increases, the percent of core over 3 in. must also increase if the same support is to be used.

In the graph, the superimposed stress and the size and shape of the opening are compensated for because the graph is used in the same area from which the data was obtained and is restricted to 10x12-ft flat-backed drifts.

However, although the curves can be used to evaluate the character of the ground in the mine areas where the data were secured, the curves may not be correct for interpretations in other mining districts. The curves shown represent a specific example and are included to present a clear description of the more general Ruff-Parkinson method of analysis.

If large openings are considered, the extent of fracturing is very important. As the width of the opening is increased, fewer fractures per unit area are possible without failure of the back. For example, if a certain rock has fractures 6 in. apart, a drift 4 ft high and 3 ft wide might not need ground support. However, the 6 in. fracture pattern would produce a more blocky and unsafe back across a wider opening. Therefore, the minimum core length used to correctly evaluate the rock probably depends to some extent on the size of the opening being considered.

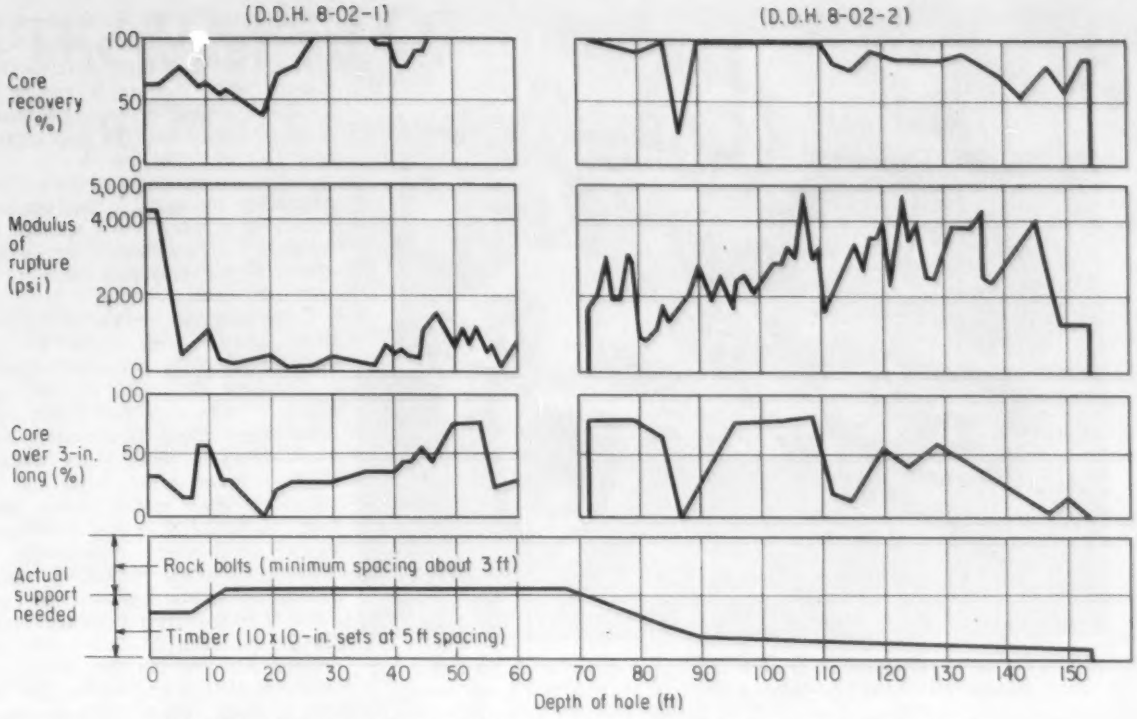
Applications Are Promising

For haulageway planning, the practical application of the results of this project was demonstrated in another section of the mine at Cananea. Diamond-drill holes were used to explore the proposed haulage level. After analyzing the cores, the proposed haulage system was changed to take advantage of the competent rock areas (see drawing on first page).

Development of the area has shown that the predictions made with the drill-core analysis were correct, and consequently, the haulage level costs were lower because practically no timber was needed.

In block caving, application of this method of analyzing drill-core data also appears to be very practical for planning new areas. By analyzing drill-core data, it should be possible to predict the smallest undercut area needed to start caving. The method is especially suited to blocks of rock which are relatively homogeneous in composition and structure. It has a more limited value in evaluating bedded deposits which have a definite discontinuity in structure between the beds or beds with different strengths.

In open pit mining, recently there appears to be a greater interest to scientifically determine maximum pit slopes. Most of the calculations for pit-slope design are based on soil mechanics and the assumption that the rock has a homogeneous character. Since the Ruff-Parkinson method of analysis considers the heterogen-



TO TRY CORRELATION of variables, each was plotted separately against depth of hole.

eous character of the rock, it is quite possible that this method can be incorporated with a soil mechanics analysis to successfully predict maximum safe pit slopes.

A patent which covers the described method of drill-core analysis is being applied for. However, permission for using the method can be obtained by contacting Dr. Ruff.

Acknowledgments

The authors would like to thank very much Mr. G. E. Jenkins and Mr. P. H. Riordan, general manager and exploration manager, respectively, Asbestos Corp. Ltd., Quebec, Can., for their interest in the project and for sending diamond-drill-core specimens which were indirectly used in the preparation of this paper.

Thanks should also be given Mr. R. S. Newlin, president, Greene Cananea Copper Co., and Mr. Albert Mendelsohn, retired general manager, Cananea Consolidated Copper Co., who encouraged the investigation. Furthermore, the authors appreciated the constructive criticism of this paper by Mr. C. P. Donohue and Mr. R. C. Weed, general manager and assistant manager, respectively, Cananea Consolidated Copper Co.

Mr. R. A. Sheldon, general mine superintendent, Cananea Consolidated Copper Co., also gave considerable help during this project.

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Rock Failure Is Theme at Colorado

THE WIDE EXTENT AND STEADY PROGRESS of current studies on producing and preventing failure in rock were clearly evident at the Third Symposium on Rock Mechanics held at Colorado School of Mines, Golden, Colo., on April 20-22, 1959. The meeting, held in conjunction with Pennsylvania State University and University of Minnesota, attracted more than 160 registrants including a number of leading international authorities and representing many scientific disciplines.

The papers, which will be available shortly in booklet form from Colorado School of Mines, covered a wide range of topics (see E&MJ Mar 59 p 118). Although most of the papers seemed to be research progress reports, all were pregnant with practical applications.

The importance of confinement and time as factors in rock failure was apparent. High confining and pore pressures and rapid loading, in effect, multiply the normal unconfined compressive strength of rock many times. The plastic and viscous nature of even normally "brittle" rock when under load—resulting in creep and permanent deformation—was emphasized. And the tremendous strain energy that can be stored in a small volume of highly elastic rock was pointed out.

A graphical-mathematical analysis of failure lent favor to tension as the basic mode of failure in rock.

Energy waves in rock, which result from all rapid loading such as in drilling, blasting and comminuting, were discussed in the light of recent experimental research.

Mine tests and mathematical methods aimed at determining energy requirements for breaking rock in drilling, blasting and comminuting were described and their common factors were pointed out.

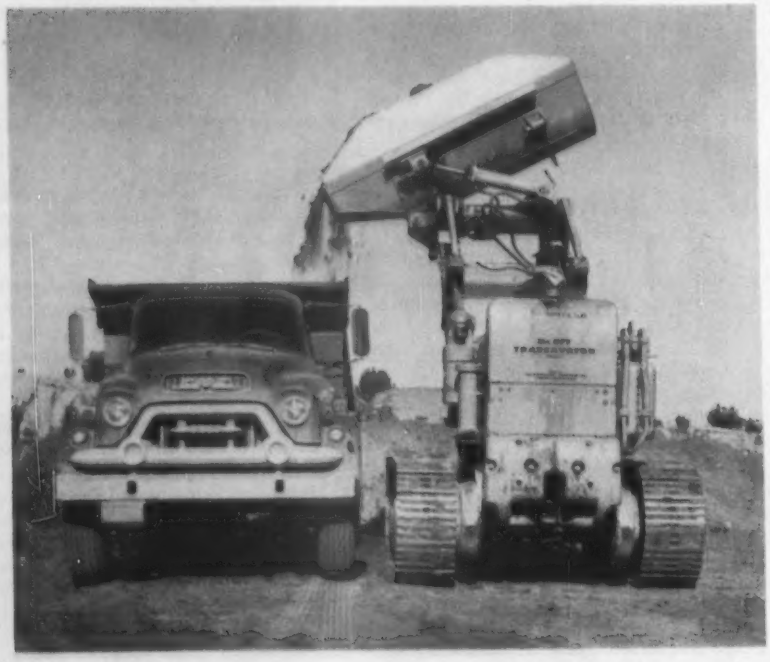
Reports on nuclear blasting were given to a "full house" and stirred much comment.

The very practical information given in papers on stability of pit slopes and on blasting techniques developed using plexiglass models, was obviously of considerable interest to the operating people that attended.

The mechanical aspects of ice were also described. And a review of some geophysical characteristics of the earth in general was given.

TRUCKER takes grab sample of uranium ore from each bucket that is loaded into truck. Samples are checked for blending quality at the mill by a geiger counter

Unit Blends Uranium Ore As It Loads Trucks



A BIG BOOST in production comes from in-line loading. The loader operator has a clear view of the truck as he backs his unit and side-dumps the ore evenly.

FOUR GRADES OF URANIUM ORE from five stockpiles in the Grants, N.M. area are being blended to close tolerances while the ore is loaded by a side dumping loader-truck team. Haulage is to two mills near Grants at a rate of 2,380 tpd.

Tonnage is estimated by the haulage contractor to within 1% (contract allowance is over 3%). Quality of blending is estimated to within .002% of the daily mill values (2% contract allowance).

Using only the number of bucket-loads as a measure, R. P. Waldie, operator of Rocky Mountain Mining & Transport Inc., loads the ore with two No. 977 and a No. 955 Caterpillar side-dumping Traxcavators into 11 GMC and three Mack trucks. Haulage distances vary from four to 18 miles over mining roads and paved highways. Presently a 10-hour, six-day work week is maintained.

According to Mr. Waldie, increased production in his operations has resulted from the larger loads the Traxcavator can pick up. But major increases are due to the machine's ability to load in-line, he reports.

In practice, a truck is backed alongside the Traxcavator until its tail-gate is about even with the rear of the machine, when the loader is digging from stockpile. As the Traxcavator backs alongside the truck, the bucket rises quickly to clear the tailgate. Material can be cast anywhere in the bed and spread smoothly as it is dumped to provide maximum loads without spillage in transit. Mr. Waldie reports that the method has almost eliminated damage to truck sideboards and bumpers.

Unit Is Versatile

In one case, working with eight trucks on an AEC stockpile with a four mile haul to the mill, a No. 977 Traxcavator averaged 260 tph trucked across the mill's scales. Production at the loading site hit 320 tph. In the operation the machine loaded and evenly spread 25 tons of ore into each truck in 2.5 minutes, including time for the truck driver to hand-sample every bucket load for a subsequent mill check on blending quality. Between loadings the Traxcavator maintained the loading area, even when the material was frozen.

The ore is a uranium-bearing sandstone, varying in consistency from loose sand to 1,000-lb chunks. It weighs about 2,600 lb per yd, with low moisture content. Tonnage is checked at the mills, where each truck is weighed. Blending quality is checked at the mill from grab samples presented by truckers. Samples are analyzed by radiation counters.

The Past and Future for Pipeline Transportation of Solids

JULIAN NARDI

PUMPING A SOLID-FLUID SUSPENSION through pipes is now widely considered in many fields as a new alternative to other means of transporting solids. Actually it is not new. While not practiced as universally as pumping homogeneous fluids such as water, crude oil, natural gas and petroleum products, solids pumping has been done on a limited scale for many years.

Of course, a mixture of a solid and a fluid is more difficult to pump successfully than is a fluid alone. However, the feasibility of such systems is not a technical problem—in spite of complexity and lack of precise values for design factors—but rather a problem of economics. Nevertheless, whenever small and/or light particles are involved—and especially if water is involved too—solids pumping often has advantages as a means of transportation. Its application promises to grow.

One of the most interesting possibilities offered by solids pumping is the partial processing of a solid while in transit in the pipeline. Such a scheme might be the key to a whole new line of products which could be economically pumped through a pipeline.

Moderate to long distance pipeline transportation of mineral and other bulk solids will not replace railroad transportation as rapidly as in the case of crude oil and petroleum products. However, as railroad tariffs continue to increase, more and more such solids will be pumped overland, especially where water transportation is not available and where a slurry or fine sizes of the solids are desirable.

For shorter distances, pumping solids is already a major method of materials handling in processing plants, especially those in the mineral industry. Mill tailings are frequently disposed of as a slurry. In excavation, and again especially in mining, hydraulicking and dredging of loose material are very low-cost operations, and both often involve solids pumping. The normal need to pump drainage water and to lift broken rock from mines also makes the application of "hydraulic hoisting" a desirable scheme. And the use of slurries to place sand fill for underground mine support has many advantages over other methods. Though not of prime concern in this article, these growing applications of solids pumping have technical and economic features in common with longer pipelines for transporting solids.

Mr. Nardi is chief mechanical engineer for Ford, Bacon & Davis, Inc., New York. He has been associated with the study and design of solids-pumping projects for more than 24 years, including the 108-mile pipeline of Consolidation Coal Co. in Ohio. This article is based on a paper presented at an American Society of Civil Engineers convention at Cleveland on May 4, 1959.

Economics Are Critical

Many proposed long pipelines for transporting solids, while technically feasible, have been not sufficiently attractive economically to warrant the financial risk involved. Until quite recently, other means of transportation were usually more economical. In some instances, the difference in transportation cost was negligible. In others, the threat of pipeline competition resulted in a reduction of the prevailing rates on the existing transportation facilities to the point where the pipeline could no longer be economically justified. In others, a competitive product was cheaper.

One related economic consideration deserves particular mention. In the last few years Ford, Bacon & Davis, Inc. has made studies of pipelines for transporting rock salt crystals in a saturated brine solution and limestone, sand, ore, lignite and coal as slurries, for distances from 30 miles to over 600 miles. Some of these were in foreign countries. While each one of these proposed pipelines had different and difficult engineering problems, there was always less doubt about the technical feasibility than the economic. In these cases it was the long term adequacy of the supply or the market, more than relative cost of transporting or of competitive products, that was most critical.

Slurry Preparation Costs

The cost of preparing the slurry for pumping and dewatering it at the terminal have also proven to be very important factors. In some instances the preparation of a slurry added enough customer value to the product to offset the cost. In other cases, the dual process was just an additional item in the cost of transportation — somewhat comparable to the railroad's switching, yard facilities, and return of empty cars. Usually this processing costs more and presents more difficult technical problems than pumping the slurry or building the pipeline.

Pipeline transportation does have two basic advantages over railroads and trucks: a smaller portion of its operating costs are in labor and materials, both of which are apparently on an upward price trend; and the cost of returning empty containers is eliminated.

In general a pipeline is more economical than the usual means of bulk transportation, such as barges, railroads, trucks, only when: (a) large quantities, (b) many years useful life, (c) high annual load factor and (d) relatively long distances are involved or when some unusual or special circumstances exist.

Technical Aspects Are Complex

The basic approach in designing a slurry pipeline is simple. The power required for pumping depends, of course, upon the pressure required to force the slurry through the pipeline. This, in turn, depends upon the topography of the pipeline, the specific weight of the slurry and the friction coefficient for the velocity of the slurry in the pipe. The distance between pumping stations depends upon the maximum acceptable pressure developed at the pump discharge and in the pipeline.

In general, large lumps can be transported short distances if the specific gravity of the solid is not too much greater than the slurry and small size solids can be transported long distances by utilizing intermediate or booster pumping stations.

However, in detail the problem becomes technically complex. As an example, some of the things that must be known before designing a pipeline to successfully pump solids are shown in the accompanying table. This points up the fact that the technical problems involved in the necessary research and design of a project require a variety of special talents and skill for their proper and successful solution.

The successful operation of a pipeline for transporting solids likewise requires considerable technical skill, especially at the start. Instrumentation can replace a certain amount of this skill after the effect of all the

Some Data Needed For Designing A Successful Slurry Pipeline

Physical Characteristics of the Solid
- The specific gravity
- The friability, grindability, and attrition rate
- The size and shape of the particles—effect on settling rate
- Screen analysis ratio of various sizes before and after grinding and screening
- Characteristics of fines in suspension (slimes)
- Wettability (surface tension)
- Solubility
- Chemical stability in air and/or water

Physical Characteristics of the Slurry
- Friction head or loss at various velocities, densities and size ratio of solids
- Critical or minimum velocity for various densities and size of solids
- Apparent viscosity and specific gravity at various densities and size ratios of solids
- Effect of temperature and pressure (solubility and apparent viscosity and specific gravity)
- Effect of agitation (thixotropic characteristics)
- Hydrogen ion concentration
- Gases in suspension
- Chemical stability of slurry
- Angle of repose of solids in slurry
- Rate and degree of separation (dewatering)

Characteristics of the Pipeline System
- Total distance solids are to be pumped
- Topography of route between terminals
- Quantity or rate of transporting solids
- Quantity and quality of water available
- Power required to pump slurry
- Spacing between pumping stations
- Maximum or optimum pressure, both pumps and pipeline
- Type of pump and drive best suited for optimum service conditions
- Availability of pumps best suited to specific slurry
- Erosion rate at various densities on:
  - Pumps
  - Pipe
  - Preparation equipment
  - Drying equipment
- Chemical treatment or additives required to:
  - Minimize corrosion
  - Minimize erosion
  - Keep solids in suspension
  - Minimize friction loss
  - Minimize dewatering and/or drying costs
  - Clean or purity drying-plant effluent (water)
- Flushing and/or drainage facilities
- Dampening and surge requirements
- Storage and reclaiming

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variables has been ascertained and the optimum operation established.

Original Adaptations Are Old

The earliest date of record of solids being transported in a pipe was in the late 1850's in California, in hydraulic or placer mining operations.[1] Where there was not enough elevation for the gold-bearing gravel to be washed directly to the sluices which separated the gold from the sand and gravel, hydraulic elevators were used to raise the water and gravel to a higher level. These elevators were venturi-type devices — water under pressure forced the material up through a pipe, from 30 to as much as 55 ft, to the desired elevation where it was discharged into a flume or sluice.

Cassiterite, a tin-bearing ore, was similarly pumped in "elevators" in Malaya prior to 1900.[2] There are records of other installations in Nigeria and Swaziland, South Africa, and in New Zealand about the turn of the century.

According to Peele's MINING ENGINEER'S HANDBOOK, flushing, which is sometimes called "slushing" or "silting" — the pumping of anthracite culm (fine waste material) through pipes into the worked-out portion of a mine—was first done in 1884 in Pennsylvania for extinguishing a mine fire.[3] It is still being done today as a means of reducing and regulating surface subsidence.

Prior to 1900, F. E. Duckham was granted a patent in England on a method of pneumatic (vacuum) transportation of solids — for unloading coal and grain from the holds of ocean-going boats.[4] In the United States his invention was known as the Darley system.

Also around the turn of the century, sand and gravel dredges were introduced into the United States from New Zealand where they were used in placer mining. While most of them were bucket-line type and disposed of the tailings by conveyors, some of them were suction or hydraulic type and used pumps and pipe both for picking up and for discharging the dredged material.

U. S. Patents Date From 1889

The earliest U. S. Patent claim for pumping solids through pipes was made by Wallace C. Andrews of New York. His application, filed March 26, 1889, described his "intention to take fine coal at the mouth of the coal mines . . . and transport it through (a) pipe . . . (for) distances of . . . hundreds of miles to towns and cities." He even specified "grinding or crushing the material . . . too large or of too great a specific gravity . . . to be carried by the momentum of the liquid, (then) introducing them into the running stream (of liquid) and, finally, separating the same from the liquid at the place of destination." He was granted patent No. 449,102 in March 1891 and is reported to have exhibited a model of his invention at the Columbian World's Fair Exposition in Chicago in 1893. No record could be found of any commercial application of his invention during the life of his patent, or of any attempt on his part to extend the expiration date by subsequent claims for improvements in the application of his process.

However, in December 1904, William T. Donnelly of Brooklyn applied for a patent on "an improved apparatus and method for transporting solids, particularly . . . coal." The method he described was basically the same as Andrews. His "improved apparatus" was primarily an attempt to implement Andrews' feed hopper by automatically "controlling the relative quantities of water and solids materials." Donnelly was granted a patent in July, 1906 but the records do not indicate that he was any more successful in exploiting his invention than Mr. Andrews.

First Used On Coal

The first commercial application of hydraulic transportation of solids in a pipe was made in 1914 in England by Gilbert G. Bell, a British power plant engineer.[5] He was confronted with the problem of getting coal from barges on the Thames River to his boiler plant which was less than 1,500 ft away as the crow flies. No direct route was available for "wagon" haulage or for any then common type of mechanical conveyors. He ruled out pneumatic conveyors as uneconomical for lump coal for that distance. Intervening streets and many residential buildings separated the power plant from the river.

After some experiments with sludge type centrifugal pumps at the power

plant, he built an 8-in cast iron, bell and spigot pipeline 1,750 ft long from the docks to the power plant, also a smaller return-water line. There were many bends in these lines, most of them, so-called long radius (3-ft radii) but a couple of them only 12-in. radius. He unloaded the coal from the barges with a clam-shell bucket into a large hopper which had a 5-in. sq mesh screen on top. A disk feeder controlled the flow of coal from the hopper into the pump sump. A 7-in. pump, driven by a 50-hp motor, delivered 50 tph of coal in a half-coal, half-water mixture at a velocity of about 4 fps.

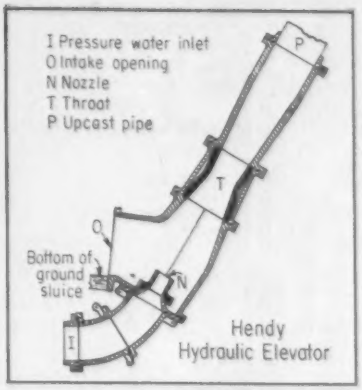
Early Plans Dropped

It has been reported that Mr. Bell proposed building other coal pipe lines, one for transporting 2.5-million tons per year from the mines in the Midlands to London, a distance of 130 miles,[6] but no record could be found that this or any other coal pipelines were built or why the original line was abandoned in 1924.

In 1921, POWER MAGAZINE & SCIENTIFIC AMERICAN both published articles describing three proposed coal pipelines.[7] One was to transport 7-million tons per year of anthracite through 200 miles of 14-in. pipe from Scranton, Pa., to the Newark Meadows near New York City (airline distance 100 miles) and another to transport 6-million tons of bituminous coal through 320 miles of 14-in. pipe from Clearfield, Pa., to New York, an airline distance of about 200 miles.

Reasons for Abandonment

While these articles demonstrated on paper the economic feasibility of the pipeline as compared with railroad transportation between the specific points, the fact remains that none of the pipelines were ever built. Economic considerations other than cost-per-ton of transportation probably made such projects unattractive. Besides the necessity of signing up long-term contracts for both supply and market, and providing sufficient storage at the terminal to smooth out the seasonal demand for the product, there were additional costs of assembling the coal at the start of the pipeline and preparing it for pumping, and then dewatering it at the terminal and transporting it from the terminal to the many distributing points in the metropolitan area. The railroads, of course, could pick up the coal from the many points near the start of the pipeline and deliver it to many points near the terminal without any such processing or rehandling.



VENTURI-TYPE UNIT was used to lift gravel in placer mining about 1860.

Other Materials Enter Picture

In 1925, Allen-Sherman-Hoff obtained a patent for hydraulically sluicing ashes and clinkers. They made several installations in central station power plants for transporting the ashes to a pit or to a waste bank—the maximum recorded distance being less than two miles.

In the late 1920's, this author designed and put into operation near Mt. Carmel, Pa. a pumping and pipeline system for transporting anthracite sludge — both coal and refuse underflow from a Dorr thickener which varied from 40 to 65% solids —to a waste bank approximately a mile away.

In the early 1930's, with the advent of the various hydraulic coal-cleaning plants, called washeries (Chance, Hydrotator, Rheolaveur, Menzies, etc.) it became common practice to pump the fine refuse to a silt bank. In 1938 the St. Clair Coal Co., near Pottsville, Pa., crushed all the refuse from their anthracite breaker and pumped as much as 190 tph of it as a 15 to 20% slurry through a 14-in. pipeline for almost a mile to behind a settling dam on the mountainside.[8]

Pipeline Transports Salt

In 1934 Ford, Bacon & Davis built for The Solvay Process Company, a 15-mile, 12-in. cast iron pipeline in Louisiana which transports approximately a half-million tons per year of salt in the form of a saturated brine.

In 1937 a feasibility study was made for a similar 55-mile line located in New York State. In both cases the customer used the salt as a brine in his process so it was not necessary to dewater and recrystallize the salt. In the latter case, the design work was practically completed and options had been obtained for a good portion of the right-of-way, when in 1939 the railroads reduced their tariff on rock salt to the point where the return on the investment was not sufficiently attractive to construct the pipeline. In 1947 and again in 1957, the economics of this pipeline were re-examined for larger capacities. Although the investment per ton of pipeline capacity had doubled in the 20-year interval, the freight rates, mining and handling costs of the rock salt had increased enough so that the pipeline may be built in the near future.

Some time in the mid-1940's the French built and are still operating a 15-in. pipeline about 6 miles long, through which they pump a 25% solids, minus ⅛-in., coal washery sludge at 7 to 10 fps, to a powerhouse where it is dried and burned in the boilers.

Phosphate Pumped in 30's

Phosphate matrix—a mixture of phosphate rock, sand and clay which includes lumps up to 6 x 9 in.—has been pumped from open pit mines to washeries since the early 1930's.[10].

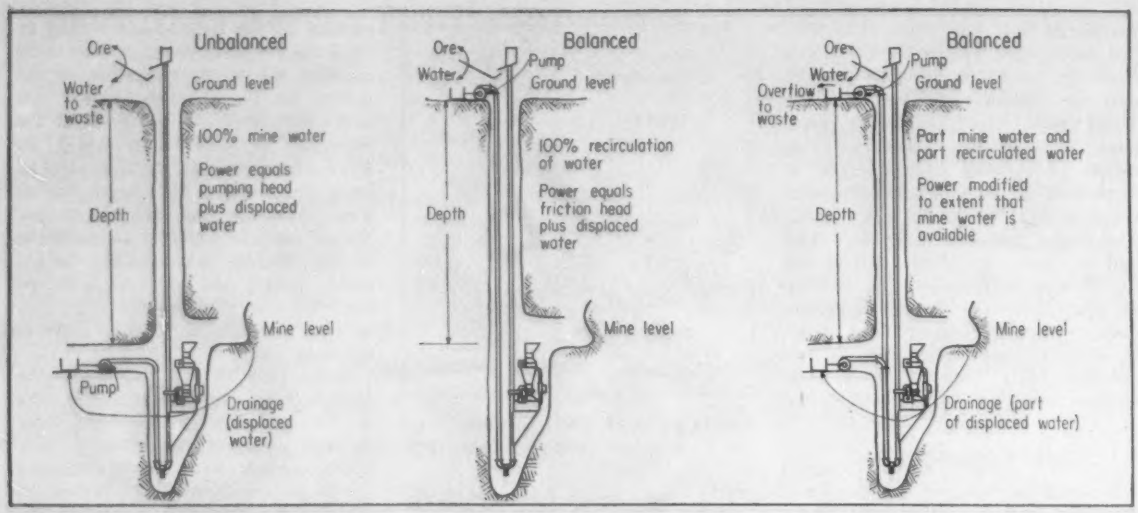
There are now 20 or more of these pipelines, 15 in Florida alone, through which over 30-million long tons are pumped annually. Most of these pipelines are 16-in. diameter spiral-welded, abrasion-resistant steel and are from one to five miles long. Those pipelines which are over one mile in length usually have intermediate booster pumps. Normally about 600 tph of matrix are pumped with some 7,000 gpm of water. This produces a velocity of 10 to 15 fps while the ratio of solids to liquid varies from 20 to 40%.

In 1949, the Virginia-Carolina Chemical Co. built a 5-mile, 14-in. pipeline to pump 150 tph of phosphate pulp (minus 8-mesh) from their mine at Clear Springs, Florida, to their Phosmica Plant.[11]

In 1950 the Thiele Kaolin Co. at Sandersville, Georgia, built and are still operating a 10-mile pipeline through which they pump a clay slurry from mine to plant.[12] The rock (kaolin) is crushed, cleaned and sized, mixed with water, pumped, and at the end of the line, dewatered. There is only one booster pump in this line. It is automatically started and stopped by instruments which also control the pH and specific gravity of the slurry.

Coal Supply Lines Restudied

In July, 1951, the U.S. Bureau of Mines issued RI. 4799 "A Survey on the Hydraulic Transportation of Coal." In it the author, R. W. Dough-



HYDRAULIC HOISTING SCHEMES can be based on using mine drainage alone or various ratios of recirculated water.

erty, described studies made by Allen-Sherman-Hoff, Koppers Co. and Roberts and Schaefer and went into considerable detail about the technical problems involved. He also presented some estimates of construction and operating costs. His conclusion was that "coal may be transported economically in pipelines, especially in large tonnages to supply a steady industrial market." He went on to say through that "before a commercially successful coal pipeline could be designed and built, many more actual pump performance data must be accumulated . . . (quantitative) erosion of pipes and pumps (must be determined), and degradation of coal, economical linear velocities, pressure drop in lines (established) for each coal mixture . . . and also pumps will require much more development."

Nickel Concentrates Pumped

In September 1951, the International Nickel Co. Ltd. at their mines in northern Ontario, Canada, started transporting nickel-copper concentrates through 8-in., and mill tailings through 13-in., ID wood-stave pipelines.[13] Two of each size and a 6-in. water line were installed, totaling over 40 miles of pipe. In order to maintain a favorable slope of at least 1%, International Nickel built over 12 miles of wood trestles to carry these pipes across valleys. The concentrates are pumped about 7½ miles from Creighton to Copper Cliff and the tailings a couple of miles further, a total of 30,000 tpd. The velocity of the slurries varies from 5 to 6 fps and the solids concentration from 30 to 50.

In November 1951, COAL AGE in an article "Moving Coal to Market" compared the then current costs of what they called the "Old Methods: by Rail, Water or Truck" with "New Methods: by Pipelines, Cross-country Belt or Pipeline Gas." In the section "Coal by Pipeline" they described Pittsburgh-Consolidation Coal Co.'s future plan to build a pilot plant and quoted the Bureau of Mines report and cost estimates. COAL AGE's conclusion was that "for a good many years to come, the bulk of the coal shipments doubtless will keep on moving by rail—not because it is cheaper (water transportation is the cheapest but is limited as to availality)—but because they (the railroads) have the facilities—and because it would take a long time and lots of money to build another transportation network that would equal the railroads."

What did COAL AGE mean by "for a good many years to come" and "it will take a long time?"

Ohio Project Takes Nine Years

Let us look at the history of Pittsburgh-Consolidation's Coal pipeline. They announced that based on investigation started in 1949,[14] they built a pilot plant in 1951 and operated it until late 1952.

April 4, 1953, BUSINESS WEEK quoted "Pitt-Consol thinks it will be economically feasible to tote coal 135 miles from Gadiz . . . to Cleveland . . . that such a line will be built as soon as customers for the coal can be lined up." The article went on to describe some of the political and technical details as well as the estimated construction and transportation costs and the savings.

A year later, the April 29, 1954 issue of IRON AGE, under the heading "Coal: Pipeline Plans Complete" said "Construction of the first commercial coal pipeline should start some time this summer."

Another year later, June, 1955, OIL AND GAS JOURNAL announced that "the first pipeline for moving coal will be started late this year."

It was still another year later, in the October 1956 issue of POWER ENGINEERING, that Mr. Hanson of Consolidation Coal Co. announced the completion of the pipeline.

Then another two years elapsed—midsummer 1958—before Consolidation Coal Co. reported it was in continuous or commercial operation.[15]

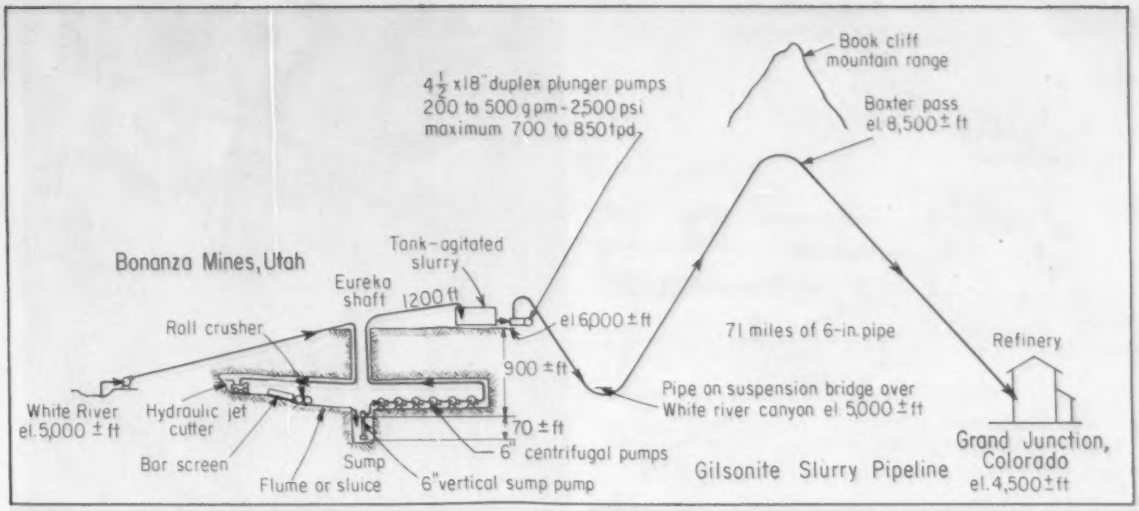
In Consol's case it took nine years from original conception to commercial operation.

More Long Lines Installed

In the meantime many other pipelines were being built for transporting solids. A 6-in. pipeline was suspended across the Snake River in Idaho in 1952 to convey a limestone slurry; in 1953, anthracite silt was dredged from the Susquehanna River near Harrisburg and pumped at the rate of 235 tph through a 12-in. pipeline from a river dock to the preparation plant on a nearby hill, 275 ft above the river.[16]

The cleaned coal was then pumped about a mile further through an 8-in. line to a dewatering and railroad car-loading plant. Borax slurries are pumped from mine to preparation plant, and in several places coal or ore are pumped from within the mines up shafts or slopes to the surface.[17]

One such installation is in Bonanza, Utah, where gilsonite is pumped at the rate of 50 tph out of the mines and then 72 miles across a mountain range


Book cliff mountain range
4½ x18" duplex plunger pumps
200 to 500 gpm - 2,500 psi
maximum 700 to 850 tpd
Baxter pass el 8,500 ± ft
Bonanza Mines, Utah
Tank - agitated slurry
Eureka shaft 1200 ft
el 6,000 ± ft
Roll crusher
71 miles of 6-in. pipe
Refinery
900 ± ft
Pipe on suspension bridge over White river canyon el 5,000 ± ft
White River el 5,000 ± ft
Hydraulic jet cutter
70 ± ft
6" centrifugal pumps
Bar screen
Sump
Flume or sluice
6" vertical sump pump
Gilsonite Slurry Pipeline
Grand Junction, Colorado el 4,500 ± ft

MINING AND TRANSPORTING of light hydrocarbon by hydraulic means has proven to be economic (E&MJ Sep 1957).

to a refinery in Colorado.[18] Three different types of pumps are used in this installation—a 70-ft long vertical submerged pump takes the ore from a sump in the mine and discharges into five centrifugal pumps connected in series. These push the slurry up the shaft about 900 ft and then overland another 1,000 ft to a preparation plant on the surface. There it is screened, crushed, desanded and mixed in the proper concentration for pumping. Reciprocating plunger pumps discharge the slurry at a pressure in of 2,000 psi into the 6-in. pipeline which conveys it the 72 miles to the refinery.

27-Mile "Transite" Line

In 1957, Ford, Bacon & Davis built the first long distance "transite" pipeline. It was 14-in. diameter, class 150, pressure type transite pipe, 27 miles long and was used for transporting salt as a brine.

In August 1957, the Soviets in their coal magazine UGOL claimed "the first long distance coal pipeline." An English translation of the article in FUEL ABSTRACTS January 1958 states: the length is 38 miles, the pipe diameter 12 in., capacity 220 tph of minus 1/32-in. coal in a 38% solids by volume slurry, 4.8 fps velocity, pump discharge pressure 1,100 psi maximum. They claimed the pipeline "transports coal three times cheaper than by rail . . . . and will release 25,000 coal cars for other services." From the figures in the original article, it appears the pipeline transportation costs are estimated to be about one third the railroad costs and the quantity pumped per year would fill some 25,000 coal cars.

Many Pipelines Are Projected

Many pipelines have been proposed for handling many different solids. Some are now being tried out on a test or pilot plant basis. Some, which are quite practical for short distances, would be uneconomical for longer pipelines. A typical example is the pneumatic transportation of wood chips for about one mile at St. Helens, Oregon.

Among the more ambitious of the proposed pipeline projects are: transporting wheat from the Canadian prairie provinces to the Great Lakes[19]; transporting wood chips in a water slurry over long distances and then near the terminus injecting chemicals into the pipeline and heating a section of it, so the product when discharged will be partially pulped en route[20]; transporting 65% nickel-cobalt crystals slurry from a concentrating plant in Cuba into tanks on a boat and then when it arrives in Louisiana, pumping the slurry from the tanks on the boat to the refinery.[21] Fluffed wood pulp is now being transported in 12,000-ton tanker-boats from British Columbia to Antioch, California,[22] and then water is added and it is pumped out of the boat into the paper mill.

The Author Recommends

In conclusion, if anyone is contemplating a solids or slurry pipeline, the author strongly recommends; first, a thorough check of the economics; then utilize all the best technical data and talent obtainable, and last, allow plenty of "lead-time" between the economic justification and the anticipated commercial operation of the transportation project involved.

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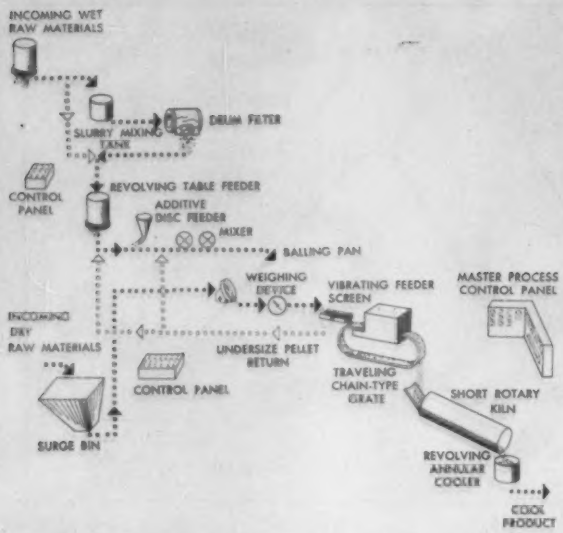
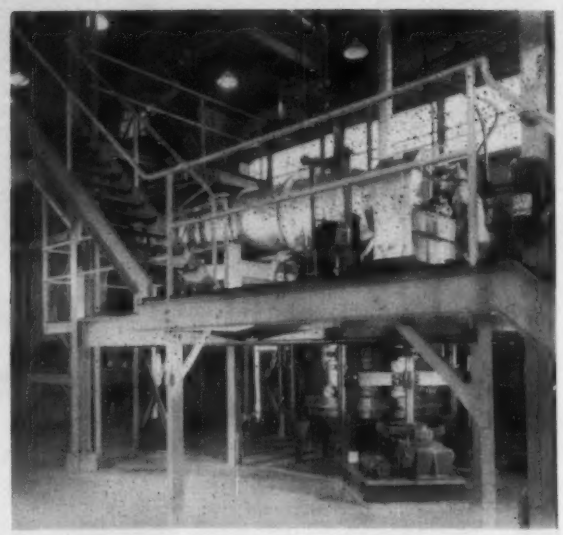


SEVERAL ALTERNATE flow patterns are provided to test dry and wet materials for agglomeration and heat treating.



CHAIN-GRATE (upper left), rotary kiln (center), and annular cooler (bottom) are key units in the new processing plant.

New Pilot Processing Plant Designed For Heat Treating and Agglomeration

W. A. SHOCKLEY

A NEW PROCESS PILOT PLANT went on stream at Carrollville, Wis., which will help metallurgists and plant designers to work out problems involved in the agglomeration, heat-treating or processing of many raw materials including hematite concentrates, natural fine iron ores, silicious bauxite, magnesite, cements, phosphate ores, dolomite and limestone. The new Allis-Chalmers Mfg. Co. Process Machinery Dept. facility is equipped with units about 1/50 scale commercial size, and a full line of modern indicating and recording instruments. Special function of the plant will be to resolve design, process and material-handling problems for operations using the "Grate-Kiln" system developed by Allis-Chalmers for pyrometallurgical processes. (See illustrations.)

The new building has three functional areas:

1. Materials receiving, storage and preparation area,

2. Balling and grate-feed operations,

3. Process area, containing the Grate-Kiln equipment, heat recovery operations, and supplementary equipment such as a pot-grate furnace for preliminary batch pyro-processing studies.

Mr. Shockley is a staff member of the Processing Machinery Dept., Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Four Flowplans

Four alternate flows are contemplated in the design, depending on whether raw materials must be prepared wet or dry, if they are metallic or nonmetallic, and whether they are fed directly into the Grate-Kiln system or require preliminary preparation or balling.

Dry process raw materials are dumped into a floor-level receiving hopper in one of the storage rooms, and moved by screw conveyor and bucket elevator to a combination surge bin and holding bin on the upper floor. The surge bin overflows to the holding bin, which is in closed circuit through the bucket elevator to keep a constant head on the surge bin. As operations call for feeding dry material to the Grate-Kiln system, a volumetric feeder and 6-in. screw conveyor draw it from the surge bin at constant head and rate, and deliver the feed to the balling pan.

Wet process feed is deposited into a floor-level bin and table feeder. Following repulping in a slurry tank, it is pumped to a 4x4-ft drum filter. Filter cake is conveyed to a table feeder supplying material to the balling equipment.

Filter cake is conveyed from this table feeder under a proportioning (disk) feeder where additives may be sprinkled onto the cake if necessary.

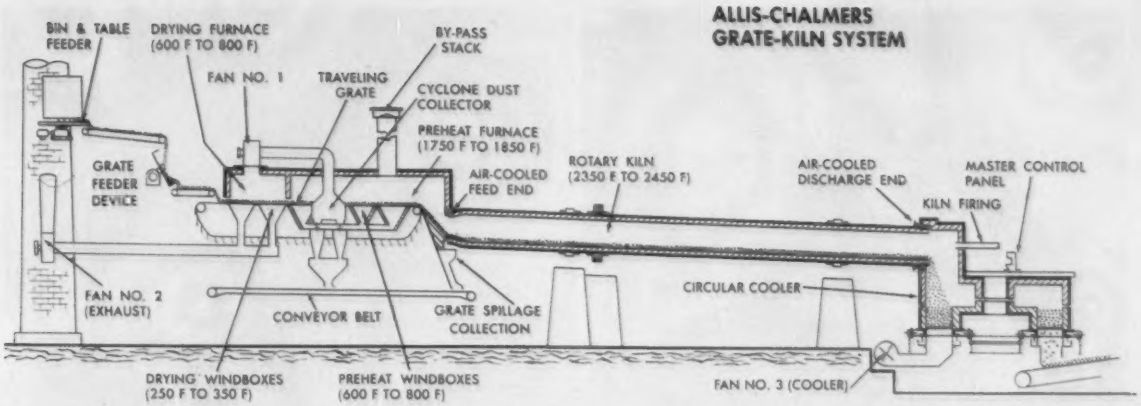
Following the proportioning feeder, a mixer is installed to produce a uniform blend of filter cake with additive. This product is fed to the balling pan.

Wet process feed which does not require repulping can be handled by an alternate system which by-passes the slurry tank and drum filter.

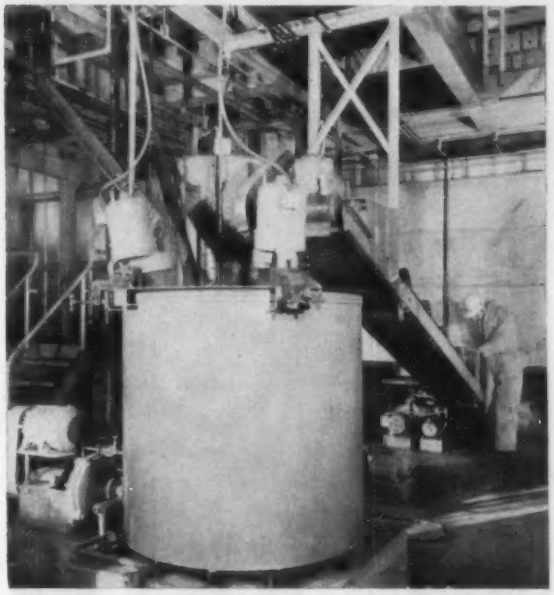
Direct feed materials such as chips, stone or ore, which do not require preparation or balling, may be conveyed directly from storage to the grate-feed area.

All of the above systems except repulping and filtering of wet-process feed are controlled from the balling control console. When repulping and filtering are indicated, an additional operator is required. This operator controls the repulping and filtering from a separate control console installed centrally with respect to the slurry tank and filter.

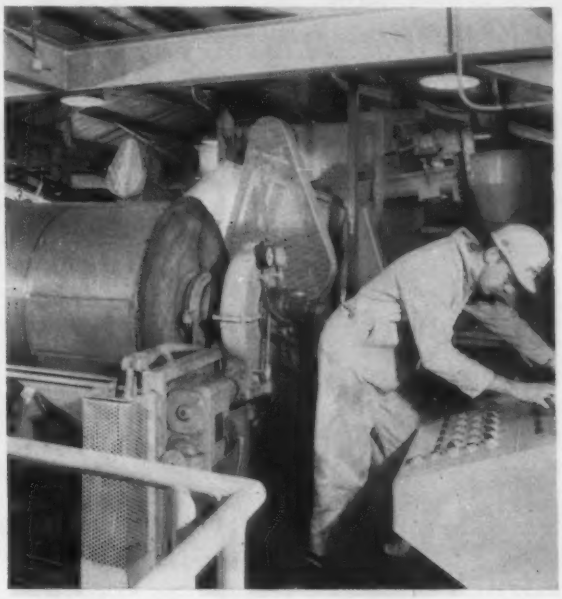
All balling is done within a 3-ft 3-in. dia A-C balling pan with variable-speed drive and hydraulic tilting mechanism. A balling pan was selected in preference to a balling drum be-



TYPICAL COMMERCIAL INSTALLATION of the A-C Grate-Kiln process designed for the agglomeration by pelletizing, and heat treatment of such raw materials as iron ore, magnesite, cement, phosphate ore, dolomite and limestone.



WATER IS ADDED in repulp tank to attain uniform moisture in feed. Feed storage bin and table feeder are in back.



DRUM FILTER dewaters slurry from repulping tank. Panel at right controls materials handling and preparation units.

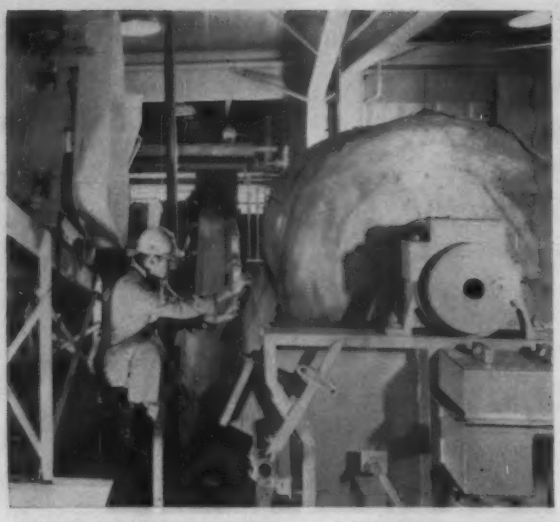
cause of the pan's versatility and adaptability. In many installations, a balling drum in closed circuit with a screen will be used commercially. However, a balling drum is not easily adapted to changing tonnage requirements and intermittent operations demanded in pilot-plants.

Ball size and product rate are varied by changing the slope of the pan, the pan speed, or the raw materials feed rate, either dry or wet. Flow meters indicate moisture addition when it is desired. Optimum size balls for pilot operations (generally ⅜ to ¾ in. in dia) are subject to a rough classification caused by pan motion. Larger diameter balls move to the lip of the balling pan and discharge onto a belt conveyor. Following this, a belt weigher determines total weight of the balls sent to the process area. This data is recorded on the master control panel.

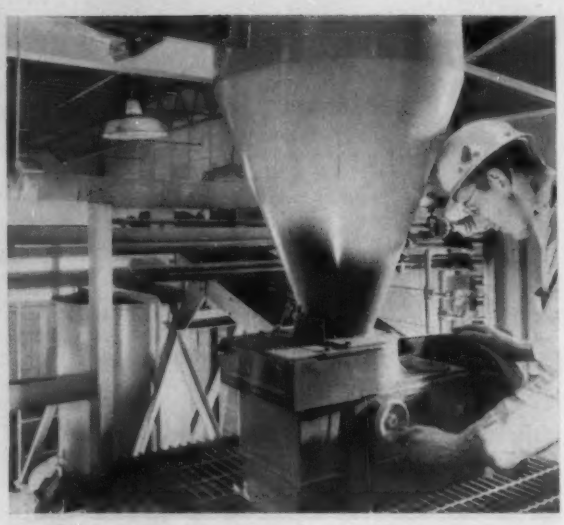
An oscillating belt conveyor distributes balls across the small vibrating feeder screen. Oversize is fed to the traveling grate. Undersize is returned to the materials handling system. Returned undersize is weighed, and this data is recorded on the master control panel. This feeding arrangement assures a uniform bed of traveling balls which are dried and processed on the grate, and minimum changes in bed permeability or pressure differential between furnace area above, and windbox beneath the traveling grate.

The Grate-Kiln system consists of traveling grate dryer and preheater using kiln exhaust gases, followed by a rotary kiln for final induration, and an annular cooler to cool the product and recuperate sensible heat. Process heat is obtained solely by the kiln burner. Green balls or other feed materials deposited by the feeder screen are moved by traveling chain grate through a refractory lined enclosure divided by baffles into a drying zone and preheat zone. Each zone is composed of the furnace above the chain grate and its associated windbox below the grate. The balls are at rest on the grate. There is no relative motion between the balls themselves, or between the balls and the grate and side plates.

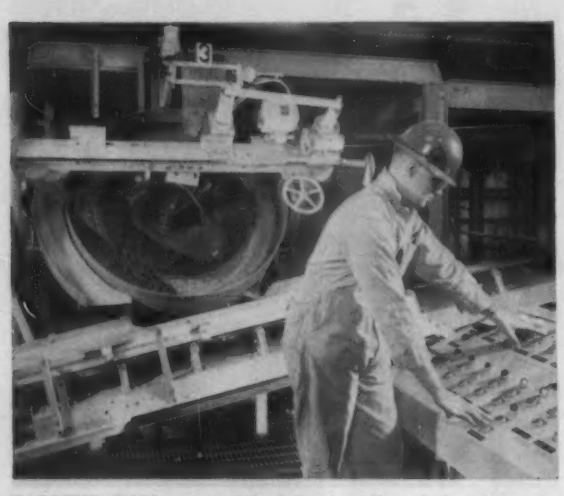
In the first chamber of the traveling grate, called the drying zone, green balls are exposed to a downdraft of relatively cool gases (700-750 deg. F.)



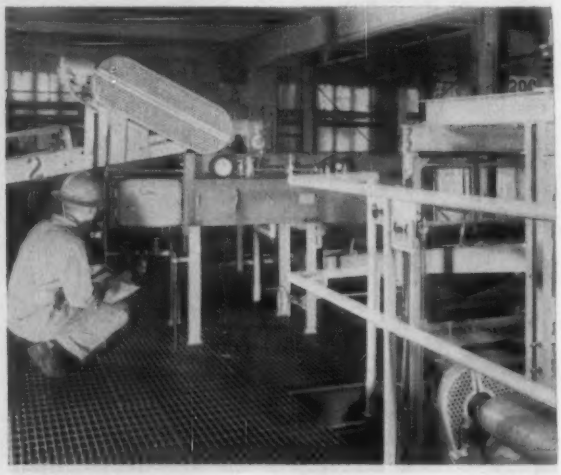
FILTER CAKE is conveyed to surge tank (background). Second conveyor (at left) takes cake from tank to balling pan.



PROPORTIONING FEEDER supplies additives to filter cake prior to balling. Bentonite is added to taconite concentrates.



BALLING PAN prepares feed for traveling chain-type grate. Operator at panel (at right) is controlling balling process.



SCALE (left background) weighs product from balling pan. Product then goes to feeder screen and traveling grate.

which dries the moist balls. Gases in this phase are making their second pass through the bed. The second pass reduced gas temperature to about 300 deg. F. Gases are then exhausted through a stack. The moist bed serves as an effective dust trap, cleaning and filtering the gases.

As the bed of dried balls passes under the dividing baffle, it moves into the preheat zone or hot chamber of the traveling grate where the material is exposed to a downdraft of hot kiln exit gases. These gases may vary from approximately 1,700 deg. F. depending upon the process involved. In this preheat zone, more than half of the heat from the kiln exhaust gases is extracted. At the same time, balls are strengthened by the indurating phase of the process. In iron ore agglomeration, sufficient strength for kiln survival is attained through grain growth and bridging between hematite particles.

Heat treatment is completed in a relatively short propane-fired rotary kiln. In commercial applications, natural gas, fuel oil, coal or any one of several by-product fuels may be utilized.

Advantages of the Grate-Kiln system are:

1. Material produced is hard, durable and can be stored and handled readily.
2. Fuel effciency is excellent.
3. Dust losses of material are low.
4. Maintenance costs are low.

How Product Is Cooled

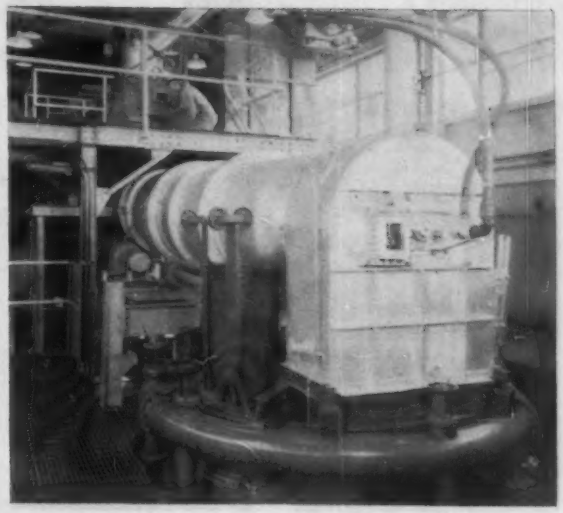
The newly developed annular cooler has two functions:

1. To cool the processed product so that it may be handled on a conventional rubber belt.
2. To recuperate sensible heat from the hot product by using heated gases from the cooling stage as secondary air to the rotary kiln.

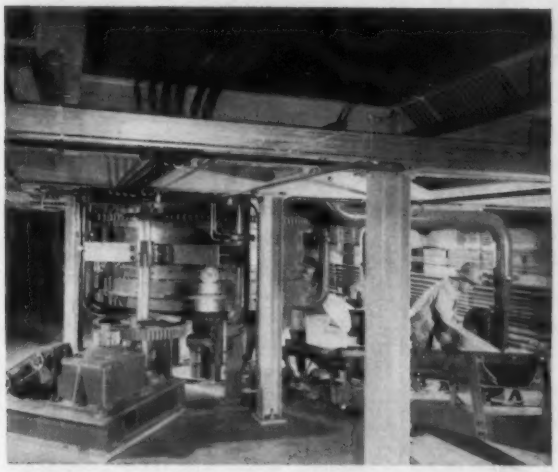
Kiln product is discharged through the firing hood into the annular cooler lying immediately below. This vertical cylindrical machine holds a bed of completely processed pellets. Pellets are cooled on a continuous basis by the machine as it rotates from the loading to the discharge point. Air, used as the cooling media, enters the coolers through multiple windboxes at pressures which force it to flow up through the pellet bed.

Products are cooled in two stages. In the primary stage, the kiln-product temperature is lowered to approxi-

TRAVELING CHAIN-TYPE GRATE drys and preheats product from balling pan. Pellets then go to kiln on lower floor.



ROTARY KILN heat treats preheated pellets from chain-type grate. Kiln product drops into annular cooler (at right).



ANNULAR COOLER, viewed from lower floor, air-cools product from rotary kiln. Cooler fan and pellet discharge (at right).

MASTER CONTROL PANEL indicates and records air flow, temperature and pressure information at A-C Carrollville plant.

mately 300 deg. F. above ambient; and the cooling air used in this stage returns the recuperated btu's to the process in the form of hot secondary combustion air to the kiln.

The second cooling zone is separated from the primary zone by a baffle. Low-temperature air from this zone is exhausted to atmosphere. Pellets are discharged at a temperature so low that they can be held in the hand. The heat-recovery features of the Grate-Chain system contribute to high fuel efficiency.

Controls and Instrumentation

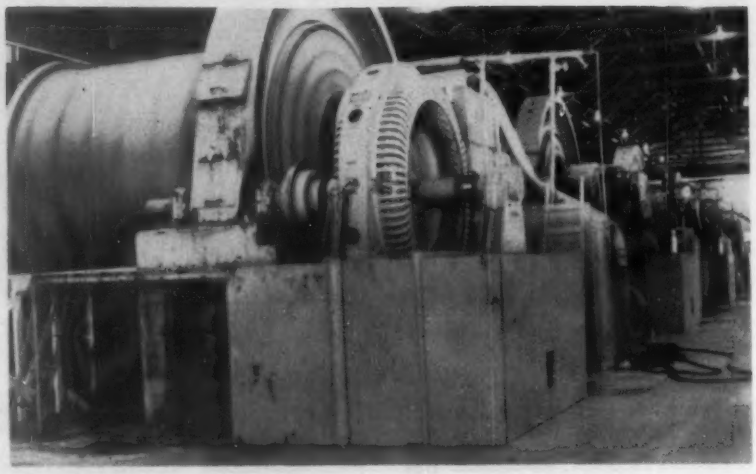
The control and instrumentation system at the Carrollville plant is more extensive than in commercial operations. At the master process control panel, indicating and recording instruments supply information on oxygen analysis, weight and rate of pellet feed to grate and amount or rejected undersize, combustion data, gas flow, temperature and pressure measurements throughout the system. With this control console operators can adjust all the process machines and related fans and process dampers rapidly and accurately by remote control.

The Carrollville facility also has its own small laboratory and workshop. Laboratory equipment includes sieves, drying furnaces, scales, compression testers and a tumble test drum for abrasion tests.

POT-GRATE experimental furnace is used to determine heating and cooling rates of small quantities of pelletized material before running multi-quantity samples in the Grate-Kiln equipment.

Southeast Missouri Milling Process —And a Ten-Year Look Ahead

H. A. HOFFMAN



AT THE FEDERAL MILL, six sets of dry crushing rolls and 36 screens were replaced when the five 9x12-ft rod mills (shown above) were installed.

IN RECENT YEARS many improvements have been made in milling throughout the Lead Belt mills. As the cost of labor and materials have increased year after year, the grade of ore decreased and the price of lead and zinc decreased, improvements had to be made to remain competitive.

In the St. Joe issue of MINING & METALLURGY, August, 1947, Mr. H. R. Stahl, mill superintendent of St. Joseph Lead Co., covered Lead Belt milling practices up to that time. A typical, simplified flowsheet (Federal Mill) of 1947 is illustrated.

After the ore was coarse crushed in 9E and 5H Telsmith crushers, it was fine crushed with 48x24-in. rolls in closed circuit with dry screens. Screen undersize went to a fine-ore bin. Feeders from this bin introduced ore into wet elevators in closed circuit with wet screens and 6½x12-ft Allis-Chalmers rod mills. The screen undersize fed St. Joe hydraulic classifiers. The classifier spigot producers went to tables where three products were made; namely, a finished gravity concentrate; a middling which returned to classifiers or rod mills; and a final tailing. Classifier overflow, containing fine slime, enriched with galena, went to Dorr thickeners. Spigot product of the thickeners was pumped to a distributor where it flowed into St. Joe pneumatic flotation machines, making a flotation concentrate and final tailing. The flotation tailing joined the table tailing and were sent to waste or sold as agricultural limestone. Thickener overflow water was used as mill make-up water.

Four mills are operated in Southeast Missouri by the St. Joseph Lead Co. These are: Federal, 14,000 tons; Leadwood, 5,200 tons; Bonne Terre, 2,000 tons; and Indian Creek, 2,400 tons (all flotation).

Each mill may be regarded as a separate problem where tests and improvements are carried through to completion. Each of the mills during the past ten years has made marked improvement in efficiency and recovery. Although these concentrators are similar in general, and follow essentially the same general flow pattern, they do have dissimilar characteristics, such as: tonnages, grade of ore, associated minerals, oxidations, grindability, and mesh at which the mineral is freed.

Mr. Hoffman is mill superintendent of the St. Joseph Lead Co., Bonne Terre, Mo. The valuable assistance which T. J. Clifford, general mill superintendent, gave in the preparation of this paper is also acknowledged.

Federal Mill

The first major improvement to take place after 1947 was in the Federal mill where 5H Telsmith crushers were replaced by 5½-ft short-head Symons cone crushers and 4x6-ft, rod-deck screens. Six of these crushers were installed, one for each section of the secondary plant. Each crusher can crush 5,000 tons of minus three-in. ore down to essentially all minus one-in. They are driven by 200-hp motors through v-belt drives at an eccentric speed of 245 rpm. They operate with coarse bowl liners. Various designs of bowl liners have been tried, including step-type liners and step mantles.

These crushers and the rod mills increased capacity of the secondary plant such that now only three crushers are necessary. One crusher has been released to the Leadwood mill to improve secondary crushing at that plant.

Another major improvement at the Federal mill was the elimination of six sets of dry crushing rolls, 36 dry screens and numerous switch back conveyors, etc., and the replacement of this equipment with five, 9x12-ft wet grinding mills.

Each of these overflow type Allis-Chalmers rod mills is driven by a 450-hp, 257-rpm synchronous motor. The gear is cast steel, cut tooth, Wuest herringbone split type, 357 tooth. The pinion is a steel, 25-tooth, forged unit, integral with the pinion shaft and reversible. It drives the mill at 18 rpm or about 66.7% of critical speed. The mills draw about 400 hp.

Rod Mill Installation

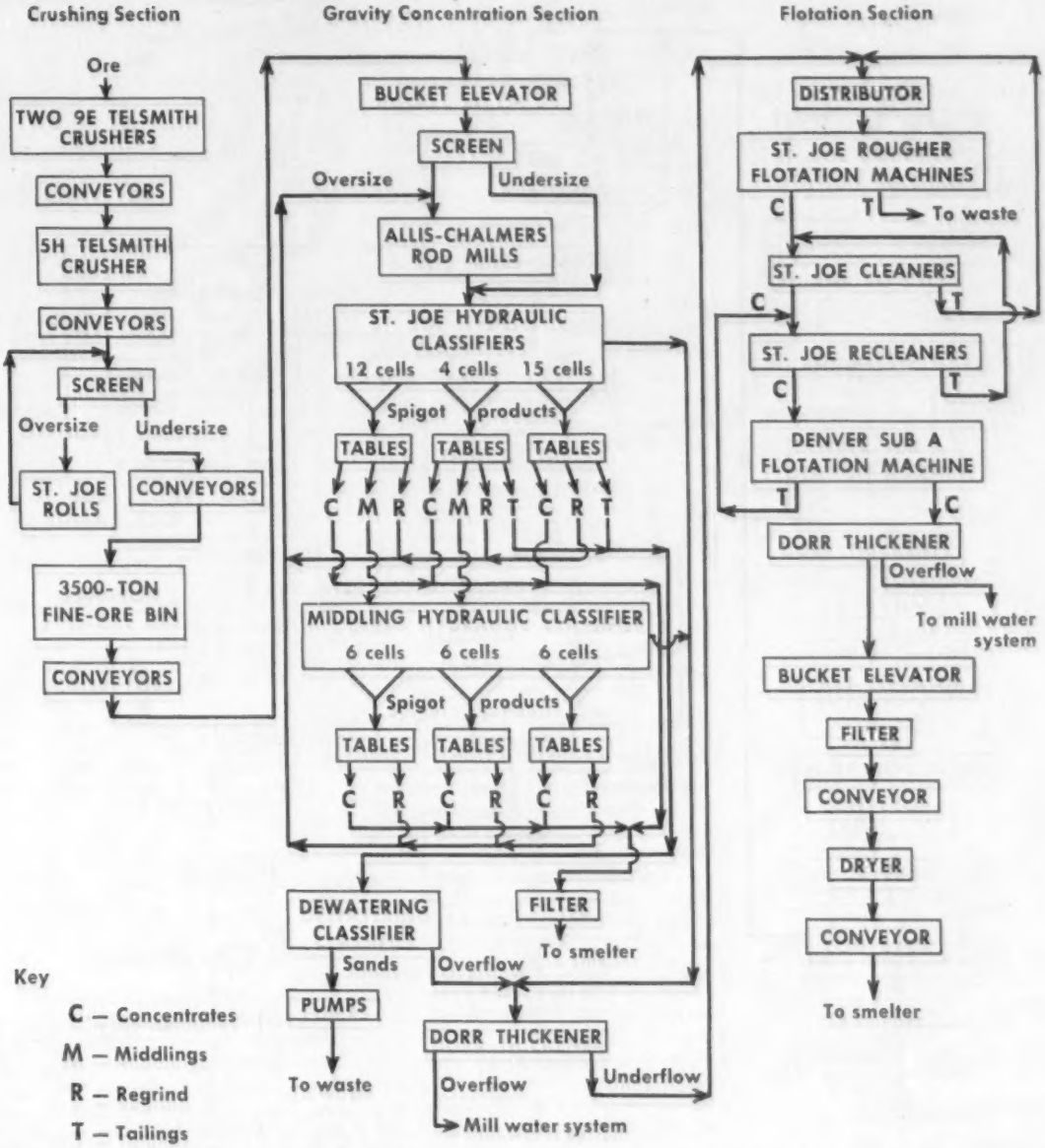
The mills operate at about 45% by volume of rod charge. Replacement rods are added each week consisting of 15, 3-in. dia rods. This averages about .20 lb of steel per ton of ore ground. Rods are introduced in the mill with a rod charger.

A spout feeder was designed to eliminate the difficulty in getting the feed into the mill. The spout and hopper are protected against chokeups by a Bin-dicator, which warns the operator when the spout or hopper is choked.

Elimination of the rolls and dry screens has greatly improved the dust condition. It also contributed toward safer operations by eliminating hazards, especially around the rolls.

A reduction in the mill organization of 20 operating and maintenance

Simplified Flowsheet of the Federal Mill, St. Joseph Lead Co., Southeast Missouri (1947)



FLOWSHEET OF THE FEDERAL MILL prior to improvements outlined in this article. Installation of new crushers, elimination of rolls and screens, and other changes reduced mill operating and maintenance requirements substantially.

shifts per day was made possible. The high cost of replacing dry screens, rolls and conveyors was also eliminated.

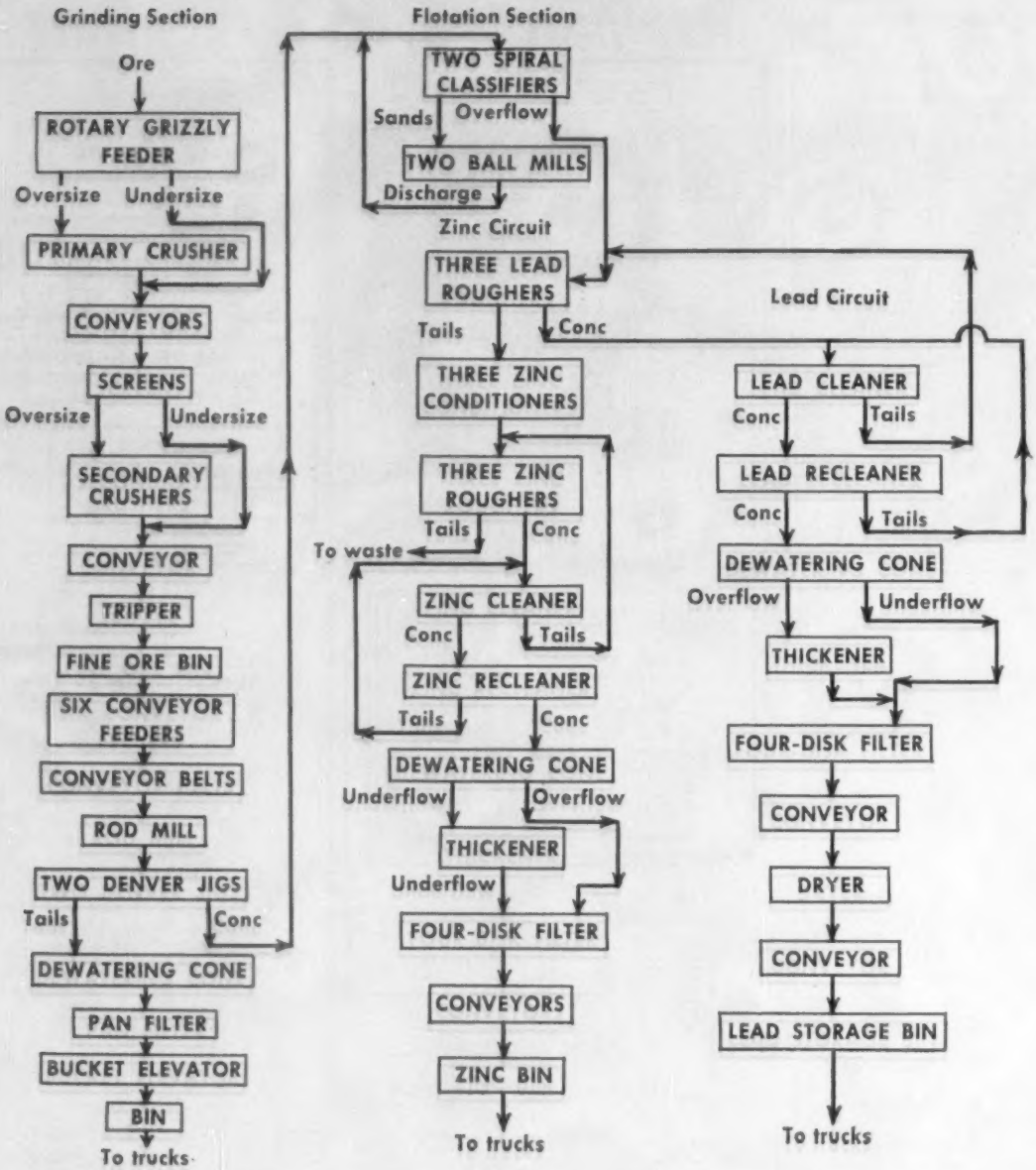
Another improvement after conversion was in the clarification of the thickener overflows. Until this change, flotation feed thickeners were overflowing dirty water during the cold weather, but they now run quite clear. This has been beneficial to the remainder of the mill.

Another major improvement at the Federal mill saw the replacement of the St. Joe pneumatic flotation machines with 66-in. Fagergren flotation cells.

The St. Joe flotation machine was an efficient cell throughout many years of service in the Lead Belt, but extensive testing eventually proved that it could be replaced by a still more efficient machine.

Accordingly, in 1955, the first bank of 66-in. cells was installed. Final installation was made in 1957. Eight banks of cells (8 roughers and 2 cleaners to each bank) have replaced 28 St. Joe roughers and cleaners. The major improvement has been in the tailing which dropped from a 0.12 to a 0.10% lead. Since some two-thirds of the ore is treated by flotation, this has resulted in a great saving. Power consumed is about the same as for the St. Joe cells. Maintenance costs are comparable to the St. Joe machines. The flotation floor is now very compact, and can be closely

Simplified Flowsheet, Indian Creek Mill, St. Joseph Lead Co., Southeast Missouri



supervised by the mill operators.

Since initial installation, many changes have been made in Fagergren units to obtain better operations. Some of these were: 1. Raising of mechanisms above the base plates by means of wood shims, varying in thickness of 1 to 4 in. This improves aeration. 2. Local vulcanization of worn impellers. 3. Installation of wear plate on the cell floor under impellers. 4. Replacing 20 rotor tubes with 10 stator tubes. This increases life of rubber tubes and by rotating these from time to time the wear will be greatly improved. 5. Replacing six "A" section v-belts with four "B" section belts. The "A" section belts required constant adjustment to eliminate slippage and decreased speed.

One bank of Fagergren flotation cells is currently undergoing testing at the Leadwood Mill.

Mill Water Supply

In the mill water system a group of pumps, each to elevate water only to the level at which it was used, was installed at a considerable saving in power cost. The pump group was also more convenient to the operator. All mill make-up water had previously been pumped into a mill tank, some 90 ft above ground level, from where it was piped by gravity to the various sections of the mill.

Spiral Classifiers

Dorr drag classifiers had been in use for many years to dewater chat tailing. These were ample at the time they were installed, but as tonnages increased these classifiers were unable to handle the heavy load efficiently, causing numerous break-down de-

Federal Mill. Comparison of Dry Screen Undersize with 9x12-ft Rod Mill Discharge

Screen Mesh	Dry Screen Undersize % Wt.	Dry Screen Undersize Cum % Wt.	Rod Mill Discharge % Wt.	Rod Mill Discharge Cum % Wt.
4	.1	.1	1.2	1.2
6	.2	.3	3.6	4.8
8	5.5	5.8	6.6	11.4
10	12.6	18.4	8.6	20.0
14	13.4	31.8	10.3	30.3
20	11.7	43.5	10.6	40.9
28	8.3	51.8	8.1	49.0
35	7.5	59.3	7.7	56.7
48	5.7	65.0	6.1	62.8
65	4.4	69.4	4.8	67.6
100	4.2	73.6	4.6	72.2
150	3.5	77.1	3.9	76.1
200	2.8	79.9	3.0	79.1
*Micron				
33	5.1	85.0	5.3	84.4
24	2.8	87.8	2.9	87.3
17	3.0	90.8	3.2	90.5
12	2.3	93.1	2.5	93.0
8	1.7	94.8	1.9	94.9
6	1.2	96.0	1.4	96.3
−6	4.0	100.0	3.7	100.0

*Separated by American Cyanamid infrasizer and calculated micron sizes.

Screen analysis made from composite samples for week ending February 7, 1953. The screen analysis indicate the rod mills made a little more minus 200 mesh than the rolls. Lead on these sizes indicated the rod mills to have slimed considerably more than the rolls.

lays. Seven Wemco 48-in. spirals were installed. This has virtually eliminated maintenance work and down time.

Tailing Disposal

Disposing of 14,000 tons of table and flotation tailings per day presents several problems, namely, disposal of this material in a convenient location, and return of water for mill use. Tailing disposal was taken care of by pumping this material through 12-in. pipelines, in conjunction with a 12-in. field pump, to a large settling area some 9,000 ft from the mill. To reclaim clarified water and protect the dam against heavy rains and flash floods, a large concrete tower and connecting aqueduct extending through the dam was installed. The aqueduct contains three compartments; one, a 3x8-ft compartment supplies reclaimed water for the mill pumps and two compartments, 8x8 ft, for control of surplus water. As the pond fills with tailing, the tower is raised by concreting the overflow weir so that a settling pond may always be maintained to clarify the water.

Cyclones

For several years, cyclones have been used for dewatering and desliming. These range in size from 6 to 16 in. in diameter. Recently 36-in. concrete lined cones have been used on tailing disposal for dam building purposes.

Test work is now done in the ore dressing laboratory, and without a doubt, more and more cyclones will be introduced throughout Lead Belt mills.

Indian Creek Mill

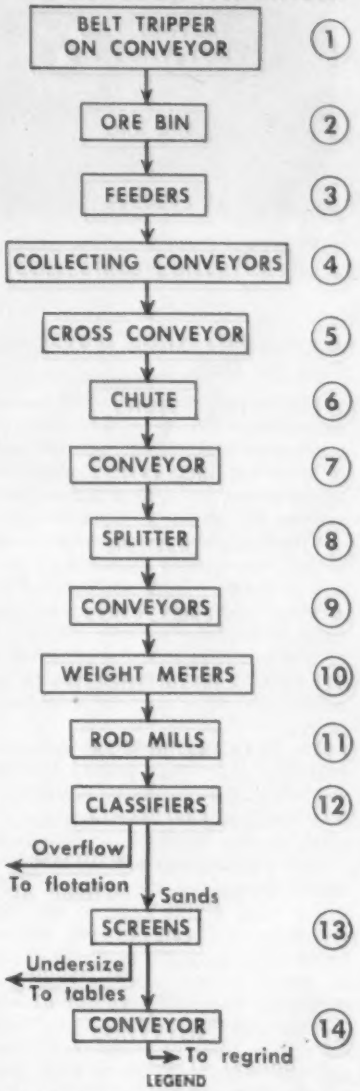
Late in 1953, this new and most modern 2,400-tpd mill began operations. Every effort was made to design this plant to be neat, compact, and to be operated with a minimum number of men with the least amount of physical effort. Those who have seen this plant, heartily agree that these features have been attained and that this indeed is a most modern and efficient concentrating plant. Provision has been made to double the capacity, if and when needed. This feature in itself is worthy of praise, for so many plants are crowded after only a few years of operation. Especially is this true of the Lead Belt mills.

Briefly the flowsheet of this flotation mill is as follows:

Ore is crushed on one shift by a Telsmith No. 25B crusher. Crusher discharge goes to two Nordberg 5x8-ft vibrating screens in closed circuit with two Hydrocone No. 460 secondary crushers. Screen undersize goes to a 2,200-ton, fine-ore bin. Feeders from under this bin feed one 9x12-ft Allis-Chalmers rod mill. Rod mill discharge passes over two Denver duplex jigs, which make a gravity concentrate for shipment. The jig overflow goes into two Wemco 78-in. spiral classifiers, which make a flotation feed and sand product, that is in closed circuit with two 9x8-ft Allis-Chalmers ball mills. Flotation feed is split between three banks of 10-cell, No. 48 Agitair flotation machines. The concentrate is cleaned and recleaned thence going to a lead storage cone, the spigot of which is filtered on a 8-ft 10-in. by 4-disk Eimco filter, dried and stored for shipment. Tailing from the lead cells is fed into two 12-ft dia by 10-ft deep zinc[1] conditioners, and thence to two banks of 10-cell No. 48 Agitair flotation machines. The final tailing and rougher concentrate is cleaned and recleaned. Final concentrate is then pumped to a cone, where the spigot is filtered on a similar filter as for the lead concentrate. It is not dried,

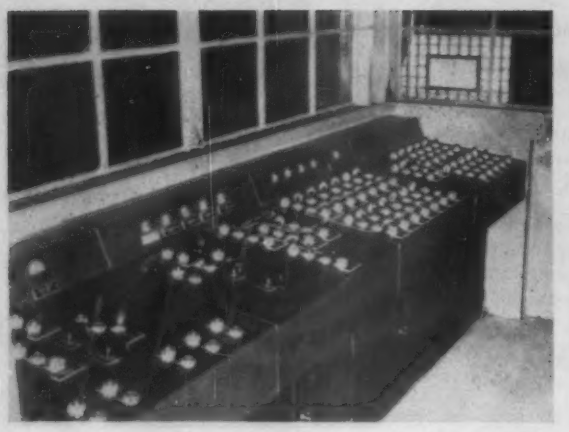
1 not presently recovered

Flowsheet of Leadwood Mill, St. Joseph Lead Co., Southeast Missouri. (1956-1957 Addition)

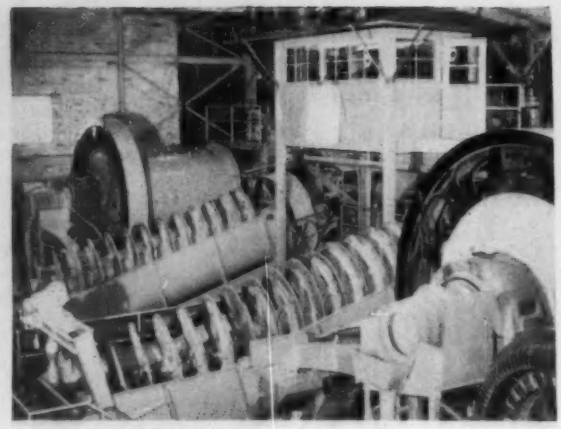


LEGEND

1. Belt tripper and 30-in. conveyor, 525 fpm
2. Ore bin, 1,930 tons live load
3. Eight 24-in. feeder conveyors, variable speed drives
4. Two 24-in. level collector conveyors
5. Inclined cross conveyor, 30 in.
6. Chute with trash collector
7. Inclined conveyor, 30 in.
8. Splitter chute, auto-adjustable
9. Two 24-in. inclined conveyors in parallel
10. Two Trans-Weigh belt meters
11. Two 9x12-ft Allis-Chalmers rod mills, 18 rpm in parallel
12. Two 72-in. Akins spiral classifiers, 3.3 rpm
13. Two Deister 5x8-ft screens, ¼-in. openings
14. Curved conveyor, 24 in.



CONTROL CENTER for the grinding and classification section of the Leadwood Mill is installed above classifiers.



UNIQUE FEATURES in this section include automatic tonnage control, automatic feed splitting and sequence starting.

but stored and shipped as discharged from the filter.

For simplification, all small motors are of either 7½, 15 or 30-hp. Pumps are standardized of SRL design with a spare for each location. Variable speed drives are used wherever convenient for discharge controls.

Crushing plant operations are controlled through an interlocking system to insure proper sequence of all crushers and conveyors and to stop units in sequence in case of failure of any one. Secondary crushers may be adjusted hydraulically, providing relief for any choke-up instantaneously.

The 9x8-ft ball mills use the same bearings, gears and pinions as the 9x12-ft, so that mill inventory is kept to a minimum, and providing for increase in size should it be necessary.

This all-flotation mill serves as a model throughout the country, indicating what can be done to simplify concentrating plants. The Indian Creek mill is simple, compact, easy to maintain and keep clean. The metallurgy exceeded expectations and maintenance and milling costs are low. Only nine operators and four repairmen are required to take care of the plant.

Bonne Terre Mill

The Indian Creek mill had a spare 10-cell, No. 48 Agitair flotation machine which was moved to the Bonne Terre mill for trial. This machine gave better results and easier operating conditions than the St. Joe machines. Therefore this plant was changed to all mechanical machines by purchasing a bank of Fagergren cells similar to those used at the Federal mill and obtaining unused Denver cells from the Hayden Creek mill for cleaning. These rougher machines were installed in series to produce a clean galena float. Higher quantities of sodium sulphide were used for the flotation of oxidized lead.

Concrete Pump Wear-Parts

Experimental work has been done to investigate the possibility of making liners, impellers and case linings of concrete with silicon carbide intimately intermixed. Many combinations have been tested; some showing excellent possibilities as to wear and cost. As this test work is expanded, undoubtedly other mills will adopt a program of using concrete parts for some of their high-wear-rate sand pumps.

Polyethylene Filter Bags

Last summer polyethylene bags replaced the regular cotton twill bag that had been generally used for many years on tthe 6-ft, 4-disk Eimco lead filter. Results indicate that this bag gives a thicker, drier cake at a decreased cost per ton of concentrate filtered. Trials are being made in all of the other mills, comparing this bag to the cotton. Tests also are being made using the polyethylene as a filter media for the 8x2-ft Dorrco filter.

Leadwood Mill

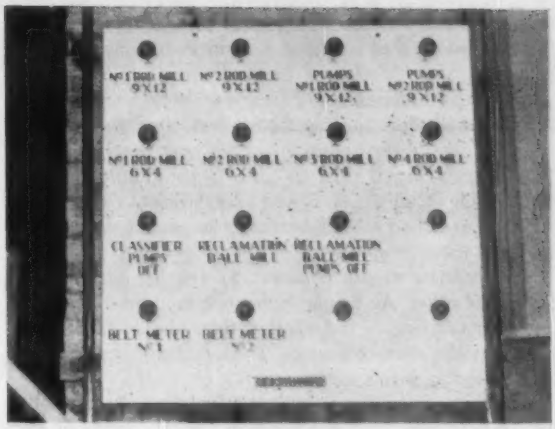
The largest and most important recent improvement at this mill was the elimination last year of four sets of 36-in. dia, 24-in. face, dry crushing rolls; four dry elevators; 12 dry screens and four feeder conveyors. This equipment was replaced by two 9-ft dia by 12-ft long Allis-Chalmers wet grinding rod mills, two 72-in. Akins spiral classifiers, two 5-ft wide by 8-ft long Deister wet vibrating screens and necessary feeder conveyor belts, pumps, etc.

These mills are exact duplicates of the Federal and Indian Creek rod mills. Thus all parts are interchangeable.

Ore is fed from the ore bin by eight feeder belts, driven by dc motors through reduction gears. Two gathering belts, one for each bank of four feeders, receive ore from any one or all feeders, transferring this feed to a common belt which dumps onto an incline conveyor. Here it is split between two belts, feeding each of the rod mills. On each of these belts is attached a "Belt-Meter" for tonnage control. Mill discharge flows to Akins spiral classifiers. Classifier overflow at 33% solids goes direct to flotation, while sands pass over ¼ in. wet screens. Tramp oversize is removed and sent to the regrind ball mills. Screen undersize is pumped to the gravity concentrating circuit.

The unique feature of this circuit is the automatic tonnage control, automatic splitter unit, and the sequence starting and stopping of the units.

Two 24-in. Transweigh "Belt-Meters" are the focal point of the automatic tonnage control for the two rod mills. Each "Belt-Meter" controls output of a motor-generator set which feeds four of the feeders under the ore bin. When one of the Belt-Meters deviates from the preset tonnage desired, it closes a contact calling for either an increase or decrease in tonnage. This contact, through relays and timers, starts a motor-driven field rheostat which increases or decreases the voltage output of the motor generator set. This voltage change will increase or decrease



WHEN EQUIPMENT STOPS, a flashing red light and siren enable operator to locate source of trouble instantly.

BINDICATORS detect pile-ups or choke-ups at strategic points, and shut down conveyors through interlock controls.

speed of four feeders connected to the motor generator set.

The timer increases or decreases tonnage at the feeders in increments. When the Belt-Meter calls for a change, the timer will allow a small change to be made and then wait until this change in tonnage appears at the Belt-Meters. If the Belt-Meter still calls for a change, the timer will allow the feeders to have another increment of speed change.

Feeder Controls

Since all eight feeder outputs are collected on one belt system and are again split between the two rod mills by a motorized splitter, a change initiated by one Belt-Meter would also show on the other. The system is designed to take care of this two ways. First, the Belt-Meter relay system is designed so that if one Belt-Meter is calling for an increase and the other calling for a decrease, the signals will be cancelled. Second, a control has been installed to drive the motorized splitter so as to hold a preset ratio of tonnage between the two rod mills.

This control consists of two rheostats, one mounted on each of the Belt-Meters. These two rheostats are balanced in a bridge circuit in such a way that if the tonnage over the Belt-Meter deviates from a preset ratio, say 50-50, the bridge circuit will become unbalanced and initiate a signal calling for the splitter to move. This signal is amplified by a magnetic amplifier to produce enough power to operate a reversing contactor and start the splitter motor to correct for the original deviation.

The Transweigh Belt-Meter consists of four major components: the carriage, the Tachometer generator, the load cell, and the ElectroniK Recorder. It operates by measuring electrically the weight of material on a short section of the belt and the belt speed, and multiplying these two variables to obtain pounds or tons per hour delivered.

The ElectroniK recorders are Brown-Potentionmeter Pyrometer, made by Minneapolis - Honeywell, having 6-mv range and 150-tph scale.

The control center of this circuit is located in the console room. This is a 7x14-ft, glass enclosed room situated above the sand discharge end of the spiral classifiers, at the splitter elevation. From this point the operator is able to watch and control the operations of all of the equipment in this circuit.

Along one wall is the waist high console on which are located the sequence controls. These are all interlocked and must be started in sequence when the selector switches are turned to automatic position. When the selector is set on hand position, it will operate out of sequence. A typical unit would have the following controls located in a vertical row from top to bottom; amber running light, hand-automatic selector switch, green starting button, red stop button and name plate. Across the top of the console are red pilot lights indicating when a major piece of equipment is down, and at the same time a siren will sound. Also on this console are located the selector switches for the feeder motor generator set. One is marked "Auto-Off-Hand" and the other marked "Dir-Off-Rev". The "Auto-Off-Hand" switch governs the control circuits for the feeder motor generator sets. In the "Off" position, none of the controls is operative. In the "Hand" position, one of three push buttons at the bottom of the panel can control voltage generated by the motor generator sets. It may be increased, decreased or centered. In the "Auto" position the "Belt-Meter" will control the voltage in response to the tonnage moving across the weigh cells. The "Dir-Off-Rev" switch controls which feeder motor generator set supplies power to the two groups of feeder conveyors, Nos. 1 to 4 or Nos. 5 to 8. In the "Off" position, neither of the sets will be connected to the feeder conveyors. In the "Dir" position, the south motor-generator set supplies feeders No. 1 to 4, while the north supplies power to Nos. 5 to 8. In the "Rev" position, the south set supplies power to feeders No. 5 through 8, and the north to Nos. 1 through 4. Thus, either generator may supply power to either group of feeders. Also, the feeders are adjusted so that a full tonnage may be obtained from either group.

Splitter Controls

The splitter control panel has two selector switches, one marked "Auto-Off-Hand" and the other marked "No.1-Both-No.2". The "Auto-Off-Hand" switch governs the method of splitter control. In the "Off," position, the control is inoperative. In the "Hand" position, the splitter is controlled by the two push buttons which are marked "right" and "left." Action will take place only while either push button is depressed. In the "Auto" position, the Belt-Meters will control the splitter position.

Bin-dicators are provided in the discharge chutes of three critical conveyors. The first is located above a trash grizzly. A pile-up of ore at this point will trip the Bin-dicator which operates a siren to notify the operator of a choked grizzly. A by-pass

Looking to the Future

THE NEXT TEN YEARS will undoubtedly see as many improvements as the past ten. Some ideas are on the planning boards, some are being discussed, while others are still in the stage of thought.

Gravity concentration may be a thing of the past. All flotation plants will be integrated as conditions permit. They offer simple, compact plants; requiring less operating and maintenance personnel and improved metallurgy.

Mechanical flotation machines probably will replace the St. Joe pneumatic machines. In nearly all cases in the Lead Belt, mechanical machines have given lower tailing losses. By replacing St. Joe machines with the mechanical a more compact flotation floor is obtained.

Cyclones will most certainly find useful and efficient applications in the flowsheet, especially in classification and dewatering. These small units will do much toward conserving mill space.

Automatic tripper controls and "Bin-dicators" may possibly be used for remote control filling of the ore bin. This will free two or three men for other work.

Automatic reagent controls will probably be developed, which may be based upon circulating load, texture of froth on the last rougher cells, residual reagent in the tailing, or perhaps, if a quick, continuous tailing assay can be developed it could be used as a control method.

A quick, continuous tailing analysis would represent a great contribution to the mill man. We hope that in this era of automation and radioactive tracers someone will develop a method which is relatively simple and inexpensive.

The Lead Belt milling plants will probably all be covered by inter-communication systems. Foremen and operators will thus be able to communicate with each other at all times. Based upon present experience at the Leadwood mill it certainly improves operations and enhances repairs.

Automation should continue to develop throughout all of the mills. As newer and more modern electronic controls are put on the market they should find their place in the flow circuits. "Push-button" mills may not be many years away.

Applications of closed-circuit television will possibly be introduced in conjunction with automation. Operators will thus be able to watch critical operations from one central control room.

A two-way radio communicating system will probably be used to connect all of the Lead Belt plants, with smaller systems for each mill to communicate with workers outside of the immediate plant area. This will do much to speed up transportation and maintenance work.

Maintenance techniques should continue to improve in the same rapid manner for the next ten years as they have in the past ten.

Materials and reagents should continue to make marked improvements year after year, thereby improving our maintenance and metallurgy.

The future of the Lead Belt mills presents a challenge. It will be met with continued improvements.

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is provided at this chute so that ore will not back-up enough to cause belt damage. The other two are located in the feed chutes to rod mills. A mill or chute choke-up will trip the corresponding Bin-dicator, shutting down the feeder conveyor, and through interlocks, all conveyors back to the ore bin. This eliminates pile-ups and serious belt damage. The operator waits until the chute has cleared before starting his sequence. Usually these down times are for only a minute or two. These Bin-dicator guards are important aids in preventing belt damage, serious spills, and in allowing the operator worry-free to watch and check his other equipment.

Amber pilot lights indicate that power is being supplied to the function where lamp lights.

All conveyor belts on this circuit are spliced endless.

Two large signal boards, with a red globe and an easily read name plate for each piece of equipment in this circuit, are strategically located so that the operator may see one or the other from either the feeder or rod mill floor. When any of the equipment stops, the red light flashes on and a siren will sound. The operator can then instantly locate his trouble.

The mill is covered throughout by Executone inter-communication system. Operators and foremen can talk back and forth, thereby avoiding costly delays and miles of leg work. It is especially beneficial in starting up and shutting down the plant.

Table Motions

Another major improvement made in the Leadwood Mill was the replacement of all the old Wilfley and St. Joe table motions with Deister Concencos, each with individual v-belt drives. This replaced the old line shaft and flat belt drives and oil consuming motions. The new installation made a neat, clean and safer working area.

Where two men formerly fell behind on table motion maintenance, now one man works only about half time on motion inspection, lubrication and general repairs. Previous to this change, one to four tables were down for motion repairs. Now rarely is a table shut down. Oil consumption was reduced from 1,800 gallons per year to less than 200.

Linatex has been used for the past year covering worn center sections of ore conveyor belts. For one-third the cost of a new belt the belt life has been doubled. Further experimentation is being carried out to fit Linatex into other repair and maintenance improvements.

Lead Belt Mills

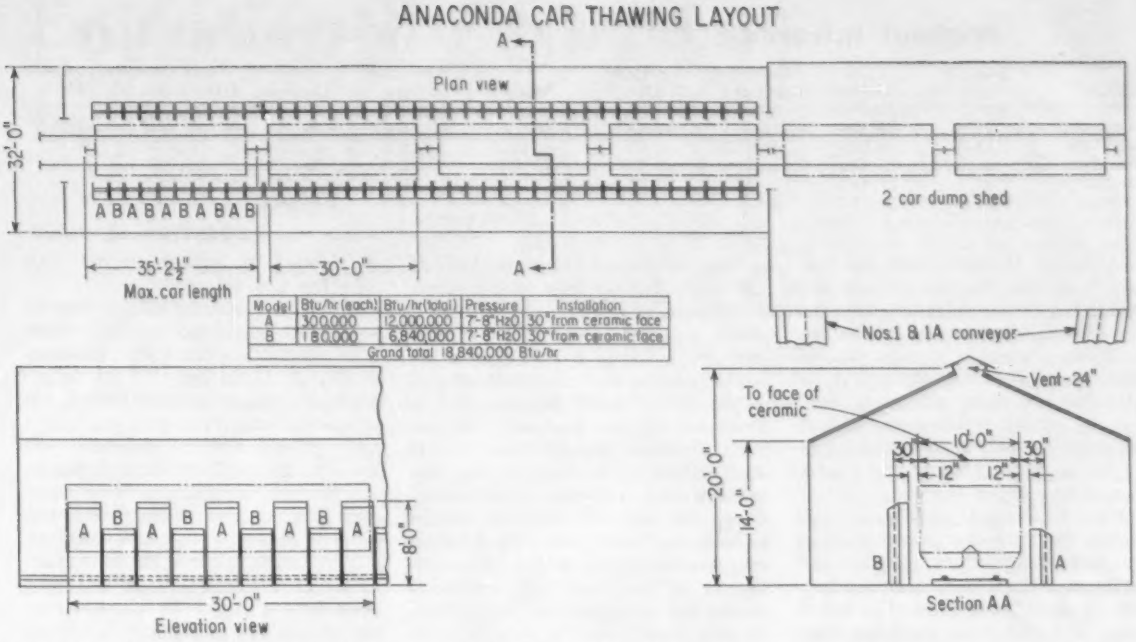
Positive control Clarkson reagent feeders have displaced old knife scraper-roller type in nearly all of the mills. Reagent amounts are therefore simply, quickly and accurately controlled.

St. Joe designed sand pumps are extensively used in all of the mills. Pumping performance has been greatly improved through the use of these job-designed pumps.

Used rod mill rods from the 9x12-ft rod mills are cut and used in the 6x4-ft, and 5x9-ft rod mills. New rods for these smaller mills are therefore seldom purchased.

Aerofloc No. 550 is generally used during the cold weather as a flocculant for the thickeners.

More than 15-million tons of reclaimed chat have been profitably remilled since 1947. Chat is not being remilled at present.



AT ANACONDA a solid bank of infra-red heaters thaw ore cars at a rate of 350 to 450 cars per day. Heaters are covered with chicken wire netting to protect them from chunks of ore that might roll off the car and damage the heating units.

Infrared Heaters Speed Car Thawing

GAS-FIRED CERAMIC INFRARED car thawing is used to speed car unloading by the Duluth, Missabe & Iron Range Ry., by Anaconda Copper Co., Vitro Uranium Corp., and Oglebay, Norton & Co. of Cleveland, Ohio during extreme cold weather. This results in increased tonnages shipped to the mill, no thawing damage to equipment, and decreased labor and operating costs.

Radiation in the "far" infrared (See box) is produced by the gas-ceramic method by passing natural gas, propane, manufactured gas, or cleaned coke oven gas through a perforated ceramic mat, where the gas is burned.

Ore will freeze to a depth of a half-foot or more along the walls of an ore carrier and form a frozen dome over the top of the car. Hopper bottoms become stuck, and even when opened the ore may remain in the car as a solid cake.

As a result, Duluth, Missabe & Iron Range Ry., who transport about 80 tons of iron ore in a 24-ft hopper bottom car, originally thawed by inserting high pressure steam lances. Steam thawing did not completely do the job and air-operated jackhammers requiring many man hours were needed to empty the car.

DM&IRR estimates it spent in the neighborhood of $1.3-million in one 45-day period during the thawing season to dump about 750 cars per day. The method took 4½-hours per car plus additional labor to remove ore by hand.

Using the infrared method, Duluth has been able to thaw cars in 30-45 minutes with little or no labor.

In 1956, infrared thawing equipment was installed at Anaconda Co., Mont. Prior to the installation, Anaconda was using 60 to 70 gas-fired lances and a two-car steam heated shed. Considerable car damage, paint burning and high maintenance costs for rolling stock resulted.

Since installing infrared heaters, Anaconda has been able to dump 150 cars per day over and above their previous rate. Normal production at the thawing facility is now 350 to 450 cars per day, enabling the firm to keep up with their smelting facilities during the winter months.

Anaconda's installation is a solid bank of infrared heaters (four cars in length) placed along the sides of incoming stock, with no heat applied directly to the bottom (see drawing). Anaconda found it necessary to eliminate bottom heaters since the type of car used has a tendency to sift very fine copper concentrates into the center of the track, burying under-car heaters in two or three days.

Chicken wire netting was placed over the front of the infrared cabinets at Anaconda to keep ore falling off the cars from damaging the heaters. See table for comparison of costs.

The infrared installation was gradually built up during the winter so the table cannot indicate the full benefit derived, although it indicates a gas saving of $0.34 per car dumped. This amounted to $18,990 on the

What Is Infrared?

Infrared rays are electromagnetic waves of energy produced by the sun, an open fire, or a heated object. Infrared radiation is of longer wave length than visible light and will heat only those substances that absorb it, not the space between the infrared source and the object.

Infrared radiation is divided into "near" and "far" infrared just as light is divided into colors. "Near" infrared has wave lengths only slightly longer than visible light while "far" infrared, the more efficient heat source, has still longer wave lengths.

Without Infrared					With Infrared				
Date	Mean F deg	Cars Dumped	Gas Used (1000 cubic ft)	Gas Cost/ Car	Date	Mean F deg	Cars Dumped	Gas Used (1000 cubic ft)	Gas Cost/ Car
Dec. 1955	22.3	9,525	13,453	$0.28	Dec. 1956	31.1	13,325	17,151	0.26
Jan. 1956	24.9	9,611	49,628	1.03	Jan. 1957	12.6	13,106	50,628	0.77
Feb. 1956	21.8	10,143	46,006	0.91	Feb. 1957	26.9	13,778	16,350	0.24
Mar. 1956	29.9	11,187	31,772	0.57	Mar. 1957	31.2	15,643	17,012	0.22
Average	24.7	10,117	35,215	0.70	Average	25.5	13,963	25,285	0.36

55,852 cars dumped over the four-month period. Further savings were realized because infrared does not damage air brake equipment as does torching. Intangible savings resulted from keeping cars dumped and not curtailing the mine production as in the past. The installation, up to mid-May 1957, cost $132,962.78. Anaconda has since completed an addition costing about $48,400.

Vitro Uranium Corp. uses infrared heaters for removing frozen uranium ore from flat bottom gondola cars equipped with 16 side-dumping hoppers at their Utah plant. The ore is heavy and only occupies about two-thirds of the car interior. Under most severe conditions, the installation has been capable of thawing two cars per hour which are hopper dumped with the assistance of a car shaker.

Prior to the use of infrared, Vitro used eight large brick-lined retorts, four along each side of the car, and fired them with natural gas, experiencing car damage and low unloading rates. Infrared has eliminated car damage due to thawing, reduced cost, and sped up the unloading cycle.

Even during the summer months infrared assisted in more rapid unloading since the units dried car walls for easier dumping.

Oglebay, Norton & Co. of Cleveland, Ohio has used infrared thawers to get savings in fuel consumption and costs in their coal loader at the Toledo Lakefront Dock. In 1955-56 Oglebay, Norton was using windbreaks on both sides of the running track for about seven car lengths, with 56 "hot dog" heaters (cylindrical metal burners) and 12 refractories, all oil fired. In 1956-57 Oglebay, Norton combined 28 hot dogs with 36 gas-fired infrared cabinets of 17 units each. There were 14 hot dogs distributed under two car lengths (between the rails) at each end of the thawing facility. The 36 infrared cabinets were spread for three car lengths in the center of the windbreaks and a partial roof was added.

Winter 1955-56
56 hot dogs using 5 gal. each.....280 gal.
12 refractories using 12 gal. each.144 gal.

Total gal. used.....424 gal.
@ 15.6¢ per gal.....$66.14

Winter 1956-57
28 hot dogs using 5 gal. each.....140 gal.
@ 15.6¢ per gal.....$21.84
36 infrared cabinets using 2.6 gal. each..... 94 gal.
@ 15.5¢ per gal.....$14.57
Total.....$36.41

Average Dumping Rate
Winter 1955-56.....14.3 cars per hr
Winter 1956-57.....22.5 cars per hr

Experiments with a propane-fired hot dog have successfully resulted in a unit which eliminates damage to running rails and ties, and operates with a lower fuel cost. Ultimately it is planned to replace all hot dogs with the new design.

Prior to gas-fired infrared thawing equipment, industrial methods of car thawing were considered generally inefficient. Hand operated oil or gas torches, oil-fired hot dog heaters between the rails, thaw pits, and steam lancing proved to be expensive and labor consuming. In some instances, the problem of thawing large numbers of cars is so acute that it has become necessary to build insulated thawing sheds that will house as many as 60 to 70 railroad cars and heat them to 175 deg F by warm air or live steam.

Electric generated infrared thawing has proven to be costly. Several railroads investigated the method and found that cost of installation is frequently prohibitive since a minimum of 700 kw per car would be required for satisfactory operation.

The efficiency of infrared equipment lies in its ability to transfer large quantities of heat by radiant energy to the surfaces of frozen ore without damage to cars, brake operating mechanisms, and paint. Production schedules have been doubled in some instances and operating costs have been decreased by 40 to 50%.

The method is patented under the trade name of Perfection Schwank Heat Generator by American Infra-Red Radiant Co. whose U. S. agent is Hewitt-Robins Inc., Passaic, N.J.

Council Warns on Ungrounded Electric Tools

BURNS AND DEATH-CAUSING SHOCK may result if portable electric equipment is not properly grounded. The National Safety Council has recommended several procedures for grounding portable equipment such as drills, abrasive tools, saws and electric hammers used in mine shops.

Equipment that appears to be in safe operating condition may have shorted, or have broken or exposed wires. The wires may make contact with metal framework of the equipment, and energize it. A shop worker who touches the framework can receive a dangerous or even fatal shock. Indirect injuries, too, may arise from use of ungrounded portable electric equipment. For example, a mechanic received a slight shock from a defective tool and dropped it on his foot—suffering a painful injury. Slight shocks have also caused fatal falls from heights.

To reduce the danger of electrical shock, it is important that a separate ground wire be provided from the tool to a low-resistance ground connection.

The National Safety Council suggests that:

1. When wiring is enclosed with metal conduit or protected by armored cable, all couplings and fittings used to make connections between the conduit or cable and the electrical equipment should provide metal-to-metal contact to assure a continuous ground return.

2. If the wiring is nonmetallic sheathed cable, or knob and tube work—such as is used in construction work—a third wire must be connected to the grounding terminal on the receptacle to provide a good conducting path to a grounding electrode or water pipe.

3. Grounding wires should be checked to see that the size is correct for the capacity of the nearest fuse or other automatic cutout.

4. No fuses, automatic cutouts or hand-operated switches should be inserted in a grounding line.

Estimating Ore Reserves Follows Logical Steps

JOHN A. PATTERSON

A RECENT REVISION of Noah Webster's dictionary defined a reserve as "that which is reserved; a store; stock; extra supply." Ore might be defined as mineral material that occurs in nature in such quantity, grade, and configuration as to allow profitable removal from the earth. An ore reserve then, should be the stock of economically minable material in a mineral deposit.

The determination of an ore reserve must be based on information varying from specific assays and measurements to geologic knowledge on the setting and habit of the orebody. The reliability, and hence worth, of an ore reserve estimate depends largely on the quantity and quality of factual data available and the location of the points that the data represent. As we move from an area in an orebody where there is ample evidence of the dimensions and grade of the ore to unknown or less well-explored parts of the orebody, we similarly move from a reserve estimate that is highly reliable to one that is less reliable. Geologic knowledge and experience with the orebodies in an area become more important as the sample data become sparse.

The geologic knowledge and experience used in an ore reserve estimate should be specific and not based on speculation. We in the mineral industry, needing at least a modicum of optimism to survive, are often prone to draw conclusions for which there actually is little evidence. We are often in the same situation as the blind men who encountered the elephant. The blind man who felt the side of the elephant knew he was dealing with something big; he thought it was a house. The blind man who examined the leg thought it was a tree; and the one who examined the tail and thought it was a snake, and did not have much basis for deciding the object was very large. Each man needed to do a little more exploring before he could draw a valid conclusion.

Defining the Classes

In recognition of this problem of varying degrees of reliability of an ore reserve estimate depending on the basic data available, various classes have been set up so that we can convey from one to another information on just what type of reserve we are talking about. The classes of proven, probable, and possible have been used for many years in the mining industry. A more recent system of classification has been defined by the U.S. Geological Survey and the U.S. Bureau of Mines. The system, adopted in 1943 by those agencies and now in common use by industry, employs the terms measured, indicated, and inferred. These classes, also used by the U.S. Atomic Energy Commission, are defined as follows:

Measured ore is ore for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are so closely spaced and the geologic character is so well-defined that the size, shape, and mineral content are well-established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to differ from the computed tonnage or grade by more than 20%.

(This class is not normally differentiated by the AEC, but is included with indicated ore.)

Indicated ore is ore for which tonnage and grade are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to outline the ore completely or to establish its grade throughout.

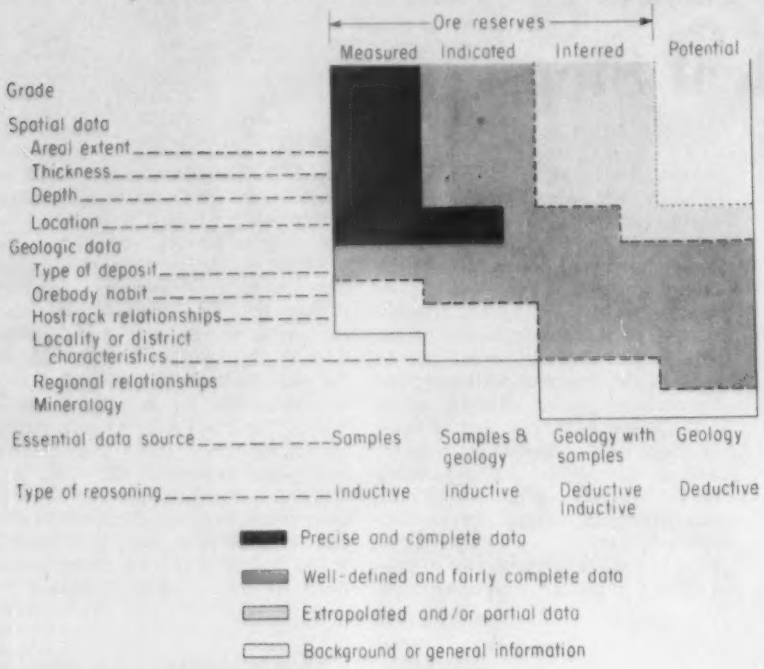
Inferred ore is ore for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any, samples of measurements. The estimates are based on an assumed continuity or repetition for which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred ore should include a statement of the spatial limits within which the inferred ore may lie.

These definitions of the classes of reserves in an ore deposit state, in essence, the following ideas: Measured ore is computed from the results of detailed measuring and sampling. These measurements and sample points must be closely spaced so that the tonnage and grade can be estimated within narrow, predictable limits. Indicated ore estimates are computed partly from specific measurements and samples and partly from projection based on geologic evidence. Inferred ore estimates are based largely on comprehensive knowledge of the character of the deposit. However, before an inferred ore reserve can be established, the existence of a deposit must have been demonstrated by specific, tangible evidence such as ore grade samples taken from outcrops, drill holes, or underground workings, or ore grade radiometric drill hole logs. Thus an inferred ore reserve cannot be established by geologic deduction alone. While specific evidence from the ore deposit is necessary, there may be no samples actually present in inferred blocks that have been projected from adjacent indicated ore.

Graphic analysis of the ore classes defined above is presented in Fig. 1. It shows the minimum types of knowledge needed and the quality and completeness of that knowledge. A "potential" category is added to complete the analysis and to show the relationship between the inferred ore reserve class and potential ore. There is often a fine line between the various classes when actually estimating

Mr. Patterson is chief, Ore Reserves Section, Grand Junction Operations Office, U. S. Atomic Energy Commission. His paper was given at the National Western Mining Conference of the Colorado Mining Association, Denver, Colorado, Feb. 5, 1959.

Fig.1 Character of Data Determines Ore Classification



the ore reserve, but each class does have certain characteristic attributes. Fig. 2 shows some typical examples.

Examining the measured class column of Fig. 1, we see the necessity for precise and complete data on the grade and dimensions of the block. In situations where we have measured ore, the geologic information is often well developed; but, we need only know and use the information about the type of deposit (vein, bedded replacement, etc.) that we are dealing with in order to make our sampling, measuring, and subsequent interpretation correct. Samples and measurements are combined inductively to give us our answer.

In the indicated class, the grade and spatial data are not as complete or well-defined as for measured ore. There frequently is one dimension along which we do not have actual samples or measurements on the ore. This dimension usually is parallel to the plane of the orebody. In order to properly estimate ore over this dimension we therefore must have better geologic information about the detailed habits of the orebody than we had for measured ore. However, the specific data that we do have is of sufficient quantity and is so located, that, with the proper use of geologic knowledge, we can make an accurate estimate. The distance between sample points over which ore can be considered indicated will vary from a few feet in very erratic orebodies to about 200 ft in extremely large continuous ones.

In the inferred class, the specific data is only a part of that which would be needed for indicated. The spacing of sample points may be too great or, if we are projecting from an adjacent indicated block, we may have no sample data within the block. Since we are basing an ore projection largely on geology, that geology must be well-established for the deposit and the locality under consideration.

The distances over which ore might be inferred vary from a very few feet up to several hundred feet in rare cases. It is impossible to state the specific distance to use in any general situation because of the variation among localities and among the orebodies within a locality. The information about each deposit must be considered in relation to the particular environment of the deposit.

It should be kept in mind that estimates made without the benefit of well-established geologic knowledge and orebody experience for the area are merely guesses as to the ore reserves that might be developed if certain hypotheses were true and if further exploration were done. Numbers derived from such geologic speculation are interesting and are an aid in program planning, but they should not be given the title "ore reserve" as though based on facts instead of speculation (see Figure 2).

Calculating the Reserve

The actual process of calculating the ore reserve involves the following steps: (1) Analyzing the basic data to determine the sample points at which we know ore exists, (2) Outlining the ore blocks as we interpret them, giving consideration to the assignment of the reserve into a measured, indicated or inferred category depending on the criteria establishing the block and (3) Computing the dimensions of the block, the volume of ore, the tonnage, and the average grade.

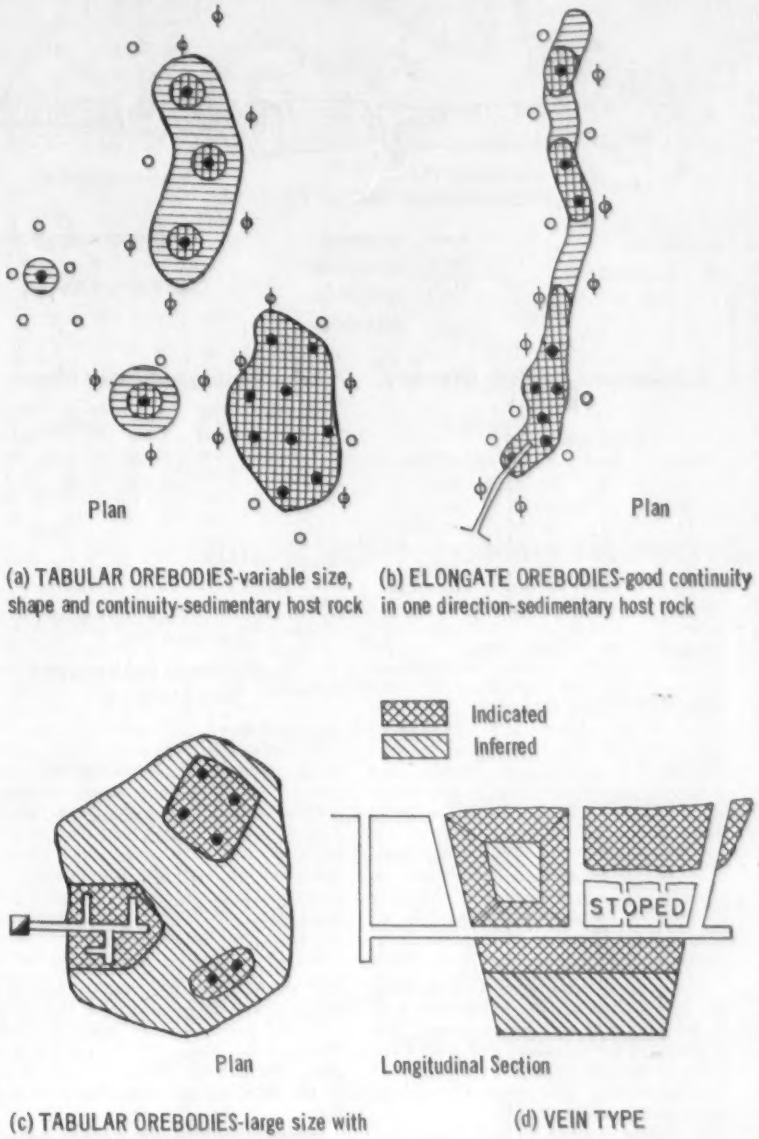
Analyzing the Data

Analyzing the Data, the first step, involves two decisions: one, the determination of the accuracy of the data and how it should be used: and two, what is ore.

The most reliable data available is probably provided by assays and measurements on core, where the core recovery is very high, and by carefully cut channel samples. Where core recovery is low or when the channel sample is really a carelessly cut chip sample, the data might be very misleading. In certain cases of low core recovery, the material lost is the higher grade fractions and the core assays are lower than they should be. In other cases, the high grade material is retained, while lower grade host rock is lost, resulting in core assays which are higher than they should be. Careful recovery of the sludge could provide a basis for a dependable correction. It is easy when cutting chip samples to get a larger proportion of the softer materials. If these soft materials are the high grade fraction, the sample will produce a higher grade than actually exists. Careful sampling of the individual ore streaks will help solve this problem. Similar types of problems exist when dry-cutting or wet-sludge samples are taken. Grab samples, because they give no dimensions, usually are of little value in ore estimation.

In uranium exploration, gamma ray logging is the commonest method now used to determine thicknesses and grades of mineralization; it is also

Fig. 2 Classification Leans Heavily on Geology



(a) TABULAR OREBODIES-variable size, shape and continuity-sedimentary host rock

(b) ELONGATE OREBODIES-good continuity in one direction-sedimentary host rock

(c) TABULAR OREBODIES-large size with good continuity-sedimentary host rock

(d) VEIN TYPE

THE "HABIT" of ore in an area is one of the major starting points for ore reserve classification. Every effort must be made to determine it as accurately as possible. In a new area this determination is highly critical and must be a major exploration effort if "reserves" is to be a meaningful term. Once the habit is known, classification can proceed.

Ore of variable continuity in tabular pods of varying size and shape is a common situation for uranium deposits. It is illustrated in (a) (*left*). One pod appears from the drilling to have continuity between a number of holes. Knowledge of the area would help one to decide if this is a reasonable expectation. Another pod has three ore holes on it, but they are spaced too far apart to allow indicated ore between them. Here an indicated block is made for each hole and an inferred block between them and around the indicated blocks. A single ore hole indicated block has been given an inferred annular ring. This is warranted by the adjacent mineralized holes and the location of the ore hole with respect to the other orebodies and the general ore trend. The other single hole block has been made entirely inferred as it is off the main ore trend and the results of the surrounding drilling limit the possibilities.

For a very strong ore trend, perhaps controlled by an ancient stream channel cut into an underlying formation, sketch (b) illustrates the approach. Indicated ore has been extended along the channel direction for some distance, but only a short distance across. Ore has been inferred along but not across the trend.

Large, tabular orebodies with very good continuity are handled as in (c) (*left*). Ore has been indicated around mine workings and groups of ore holes, and inferred between the indicated blocks.

A vein type deposit is shown in (d) (*left*). Ore is indicated where exposed in mine workings and inferred at the center of large blocks of indicated ore and in projections into unexplored ground at depth. The block above the stoped area might be considered as measured if the distances were appropriate.

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the method most likely to mislead. A gamma log, to be of any value, must be made on equipment, which is properly calibrated, frequently checked, and consistently used. To properly interpret the log, once it has been obtained, one must know the characteristics of the equipment and the character of the ground being logged. Correlation with chemical assays from a number of cored holes with high core recovery is a must for proper interpretation. Only in this manner can one compensate for the vagaries of ore equilibrium, hole conditions, instrument and operator individuality and procedures in interpretation. There are several methods of gamma log interpretation in use today; most are variations of the basic concept that the total counts registered through a radioactive zone are proportional to the thickness of that zone multiplied by its average grade. Because of the variation of equilibrium within orebodies, varying hole conditions and equipment aberrations, the results interpreted from any one hole can be considerably in error; the average results from interpreting a number of holes in an orebody, however, can approach the actual average for the orebody and thus give useable data.

As to what constitutes ore for the deposit being considered, many considerations are involved. However, the problem resolves into this: What is the minimum thickness that can be mined with the mining system that we envisage for the orebody, and what is the minimum grade that we can mine at this thickness that will repay the cost of mining? The answers can only be obtained by a study of the mining methods and costs involved. The thickness and grade combination decided upon, often called the cutoff, is the minimum that we will call ore.

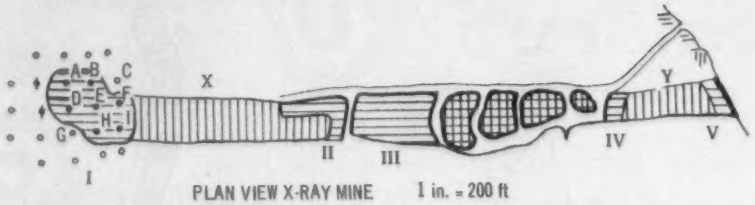
Fig. 3 Random Sample Scheme Is Simplest

THE GENERAL OUTLINE METHOD of constructing ore blocks and computing tonnage and grade is a simple system used by the AEC.

Let us look at the Block I, the drilled out ore block. The sample data has been examined and the holes that have been identified as ore intercepts are marked as such on the map; similarly mineralized and barren holes are identified. It is usually handiest to record the thickness and grade combination for each hole right on the map. Since the drill hole spacing is close enough to allow us to consider the area as indicated ore, we outline the ore block as the data requires. A line is drawn around the periphery of the block, paying attention to the values in the adjacent mineralized holes, and the vertical location of the ore—it must all be in the same horizon. On completing our line we have an ore block with a number of samples within it.

Similar analysis results in the measured blocks of ore in the mine pillars, the indicated ore blocks exposed in the workings and on the outcrop, the inferred ore block projected between the ore exposed on the outcrop and underground, and the inferred block projected between the drilled ore and ore exposure at the limits of the underground workings. Each of these blocks is drawn keeping in mind the definitions and criteria for the various classes of ore.

Once we have outlined the ore blocks, we are ready to compute the tonnage for each block. As illustrated in Fig. 3 for the drilled block, the average thickness is computed by averaging the thicknesses of the sample points within the block. This is simply the sum of the thicknesses divided by the number of samples. The area is easily obtained from the map by using a planimeter, which measures the actual map area in square inches; using the map scale, we can compute the area in souare feet in the block. This area multiplied by thickness produces the block volume. The volume of ore must be converted to tonnage by dividing by the tonnage factor, a number based on specific gravity measurements that tells us how many cubic feet of rock in the ground are needed to make a ton of ore. These items can be combined into the formula shown in the table.



PLAN VIEW X-RAY MINE 1 in. = 200 ft

- Ore hole
- Mineralized hole
- Barren hole

Ore showing
Measured ore
Indicated ore
Inferred ore

Tonnage factor = 14 cu/ft per ton

Cutoff = 4 ft at 0.20% U_3O_8

Calculations Drilled Orebody, Block I

Hole	Thickness feet		$\%U_3O_8$		Product
A	5	×	0.22	=	1.1
B	4	×	0.30	=	1.2
D	8	×	0.25	=	2.0
E	6	×	0.30	=	1.8
F	5	×	0.24	=	1.2
H	7	×	0.22	=	1.54
I	4	×	0.28	=	1.12
Totals:	39				9.96

Avg. thickness $= \frac{39}{7} = 5.6$ ft

Avg. grade $= \frac{9.96}{39} = 0.25\%$

Area (planimetered) = 0.26 sq in.

$$\text{Tonnage} = \frac{\text{Avg. thickness} \times (\text{map scale})^2 \times \text{map area}}{\text{Tonnage factor}}$$

$$\frac{5.6 \times (200)^2 \times .26}{14} = 4160 \text{ tons}$$

Combining Indicated Blocks

Block	Tons		Grade		Product
I	4160	×	0.25	=	1040
II	600	×	0.28	=	168
III	2100	×	0.24	=	504
IV	240	×	0.20	=	48
V	350	×	0.25	=	87.5
Totals	7450				1847.5

$\frac{1847.5}{7450} = 0.248\%$ U_3O_8 Average grade for Indicated Ore

Calculations for Inferred Ore Block "x"

Block	Avg. thickness	Average grade
I	5.6	0.25 (One side of block)
II	4.8	0.28 (Other side of block)
Block "x"	5.2	0.26

$$\text{Tonnage} = \frac{5.2 \times \$40{,}000 \times .42}{14} = 6240 \text{ tons}$$

The grade is determined by combining the sample data for the block according to the length of samples as shown. The products of the thickness and grades are summed up and divided by the sum of the thicknesses. The resulting average grade in this case is 0.25%.

A similar procedure is followed for the other measured and indicated blocks, using channel sample data for the ore exposed by underground workings. For the two inferred blocks the thicknesses and grades of the adjacent indicated blocks are used to determine the thickness and grade for the inferred block. The inferred block "x" in Figure 3 is given the average thickness and grade of the adjacent indicated Blocks I and II.

When combining the various blocks, the average grade is determined by weighting according to tonnage as illustrated for the indicated blocks.

Other schemes are shown on next page.

Lower grade material will not be included regardless of thickness; thinner material is included only where the grade is the high enough to allow dilution to something better than the cut-off thickness and grade. Thus, using a cut-off of 4 ft @ 0.15%, a 10-ft 0.06% sample would not be acceptable, but a 2-ft @ 0.30% one would be: Consideration of the detailed data for a sample point enables one to arrive at the optimum thickness and grade combination appropriate for the cut-off and mining method.

While the cut-off tells us what should be mineable as far as operating costs are concerned, the final tonnage and grade of the orebody must provide sufficient margin of dollar return after mining to pay for the cost of developing the property. If there is not enough margin to repay this cost, it is not a mineable ore reserve under existing economics, regardless of how cheaply you could have mined a ton of ore once the property was developed and the development cost amortized.

Constructing the Ore Blocks

After we decide what our data is telling us and what is ore, we can proceed with the next step; constructing the ore blocks.

The General Outline Method, a system used in the AEC, is explained and illustrated in Fig. 3. It uses an approach in drawing the ore blocks and in the calculations that considers the sample points as random samples in the ore body. Each sample in a block has equal influence in determin-

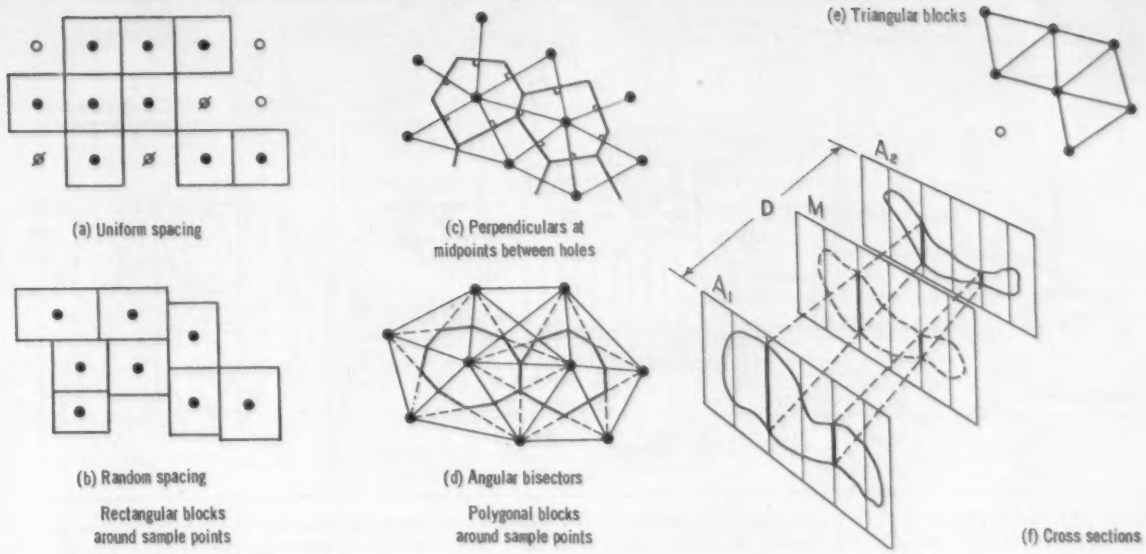


Fig. 4 Other Systems Fit Specific Needs

SKETCH "a" shows a system using squares. This is very convenient if the drill holes are on a uniform grid. If the grid varies, we end up with the pattern in Sketch "b". Note that the influence from a hole is extended halfway toward the adjacent holes. This system is very useful to keep reserve calculations current with drilling progress.

More complicated systems are shown in the center of the illustration above. Sketch "c" uses perpendiculars erected at the mid-points between holes to form the boundaries of the block. For a square drill hole grid, the blocks would end up as the squares of Sketch "a". The system illustrated in Sketch "d" uses bisectors of the angles formed on the outer corners of the triangles formed by lines connecting a hole and its adjacent holes. The bisector lines are connected as shown to form the blocks.

Two systems in use that do not form a block for each sample point are illustrated on the right. Sketch "e" illustrates a system that forms triangular blocks by connecting the holes as shown. (See "How to Estimate Ore Reserves" by H. J. Wolf in E&MJ December 1958, p 92). The triangles should be of uniform shape and ore thickness for best results. This system is most accurate for blocks that form equilateral triangles; where the triangles vary from the equilateral condition, a correction should be made by adjusting sample weights proportionately to the angular variation from the 60 deg that prevails for the equilateral triangle. The similarity of this system to the polygon system in Sketch "c" is apparent when we notice that the polygons are really constructed of pieces of the triangles connecting the holes.

Sketch "f" illustrates the cross section or fence line system. This is often used where rows of holes have been drilled across a deposit, the distance between the rows usually being considerably larger than the distance between holes within a row. In this system, the cross sectional area is determined for two places where the orebody has actually been measured and in an interpolated section. The data are used in this formula:

$$\text{Volume} = \frac{D}{6}(A_1 + 4\ M + A_2)$$

Where: D is the distance between end sections; A_1 is the area of section at A_1; A_2 is the area of section at A_2; and M is the area of interpolated section at M. The middle cross section is given more influence than the end sections. Dividing by 6 produces the average cross sectional area. This system can be used for vertical orebodies also, where the sections become level plans.

ing the average grade and thickness of the block.

There are other systems commonly used to organize ore blocks. Most of them construct an ore block for each hole or sample; the thickness and grade of the sample are the thickness and grade of the ore block. The boundaries are drawn around the block on the basis that the influence of one sample should extend until the influence of another sample takes over, which would be at the mid-distance between two samples. In these systems the influence of a hole is related to the area of its block, a factor often related more to the problems of drill site selection than the value of a sample. The most important of these systems are illustrated in Fig. 4.

It can be seen that all of these methods involve more work than the General Outline Method; either in the construction of the blocks or in the subsequent calculations. The more blocks you create, the greater will be the calculation effort. Systems detailing blocks for various parts of an orebody are often misleading for uranium orebodies as one can rarely find the actual tonnage or grade calculated for a detailed block, though the average for the orebody obtained by combining all the blocks probably will be a reasonable estimate.

Computing the Tons and Grade

The computation of tons and grade is the final step in ore reserve estimation and is similar for all methods. In general, each block is computed separately and then totaled in appropriate combinations of classes, as explained in the General Outline Method. More details are available in USBM Bulletin 356 "Sampling and Estimation of Ore Deposits" by C. F. Jackson and J. B. Knaebel, 1932, as well as most texts on field geology and mine examination and valuation.

In conclusion, the estimation of an ore reserve involves consideration of samples and measurements together with specific information on the geologic setting and habit of the orebody. Analysis of the data available enables recognition of ore, and construction of measured, indicated, or inferred ore blocks. Computation of the volume contained in each block, conversion to tonnage, and grade computation completes the process.

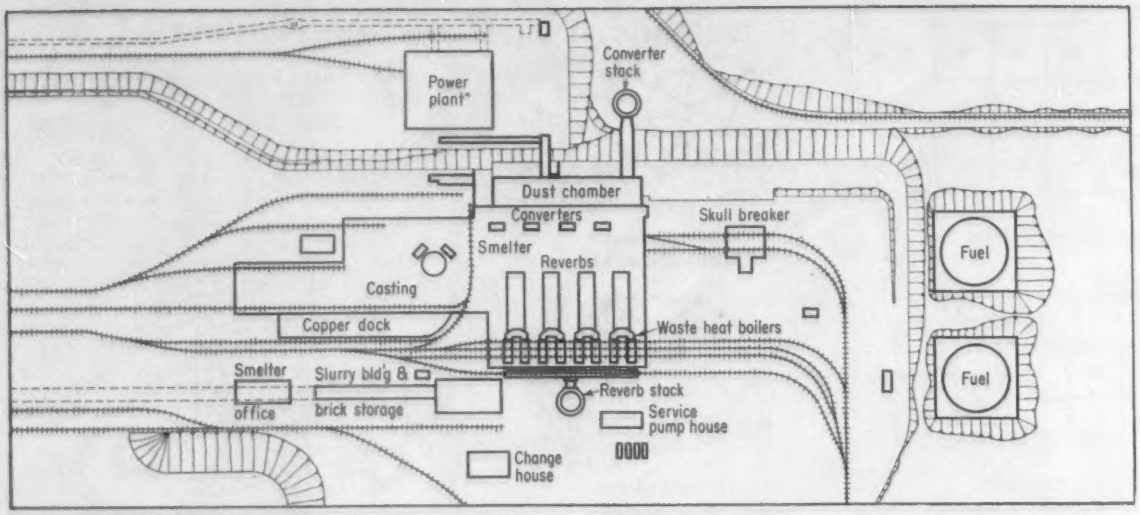


FIG. 1. GENERAL PLAN of Chile Exploration Co.'s modern copper smelter at Chuquicamata, Chile, shows the location of two 300-ft stacks which were selected to serve the smelter instead of a single 600- to 650-ft stack as originally planned.

How Anaconda Engineers Designed An Earthquake-Proof Smelter Stack

CHILE EXPLORATION CO.'S SULPHIDE ORE PLANT is situated at an elevation of approximately 10,000 ft in the mountains of Chile where earthquake tremors are almost a daily occurrence. The entire plant was designed to resist earthquake forces but the greatest difficulty in providing satisfactory resistance was encountered in the planning of the smelter stacks.

The general plan of the smelter as finally built[1] is pictured in Fig. 1, where separate stacks are shown serving the converters and the reverberatory furnaces. This article reviews the studies which led up to adoption of the final design for these stacks.

It was thought desirable to build a reinforced concrete stack 600 to 650 ft high with a top diameter of 30 ft for the first units and then to build a similar one for the extension of the smelter when and if the capacity of the plant was increased. The height of such a stack would probably be sufficient to provide enough natural draft even in the rarified atmosphere of the Andes Mountains.

The following general specification was used to estimate the horizontal seismic forces to be assumed in the design:

Bottom one-third	0.10g
Middle one-third	0.15g
Top one-third	0.20g

Mr. Dunham is a structural consulting engineer for Anaconda-Jurden Associates, Inc.

CLARENCE W. DUNHAM

Increase of the factor with height was considered necessary because of the tendency of a tall, slender structure to "whip."

The stack was to have an acid-resisting brick lining (over Fiberglas insulation) at least 13½ in. thick for the bottom third of the height, 9 in. thick for the middle third, and 4½ in. thick for the remainder. This was necessary to protect the structure from heat under full operation, and from condensation and acid if partial operation allowed the temperature to drop below the dew point—perhaps 400 deg to 500 deg F.

The soil was sandy gravel (caliche) cemented with desert salts. Safe bearing pressure was approximately six tons per sq ft. A safety factor of two was preferred.

Fig. 2 pictures some of the studies which were made. The following comments refer to each of the designs shown.

(a) This was a design for a somewhat conventional reinforced-concrete stack with the brick lining supported on concrete corbels 30 ft apart, and with a 2-in. layer of Fiberglas insulation between the concrete and the bricks except on top of the corbels. A slip joint was to be provided at the corbels to permit local expansion of the lining. To get the necessary strength and stability, this structure turned out to be very heavy and costly. Furthermore, the flue opening, which was to be at least 15 ft wide and 40 ft to 50 ft high, caused a serious weakness and the concentration of stresses near the base in a critical location, especially when the lateral forces acted perpendicular to a vertical plane through the axis and the flue opening. It also had to be admitted that no one could be sure of the magnitude of the earthquake shocks. It was finally decided that the great cost of this design was not justified because of the uncertainties involved. Stack failure would have required the entire plant to shut down

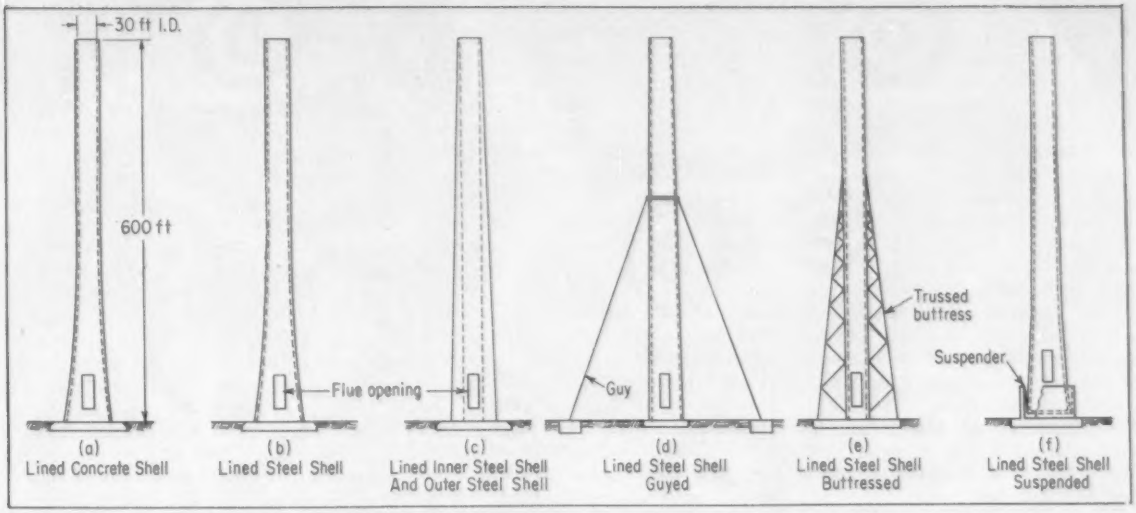


FIG. 2. THESE SIX BASIC DESIGNS were investigated before the decision was made to erect two shorter stacks instead of one tall one. See text for unique design principles and the objections to each of the smelter stacks shown above.

for an interval of many months.

(b) A steel stack with a cylindrical top and belled bottom was tried next. The brick lining was to be held on steel shelves, and insulation was to be omitted. This stack was much lighter than the concrete one, and adequate reinforcement around the flue opening could be provided. However, the structure would still be very costly, and the problem of corrosion, especially at and near the shelves, made the longevity of the service extremely questionable. Another disadvantage was the likelihood that such a flexible structure would vibrate enough to shake off the brick lining.

(c) The next step was to change the shape of the steel stack to that of a frustrum of a cone, as shown in the sketch. The lining was to be cylindrical and placed inside a cylindrical steel shell which was supported on the concrete mat and free to expand vertically but held laterally by rings attached to the outer shell. In reality, this was a design which placed one slender stack within an outer one, the latter providing for resistance to earthquakes. As was to be expected, this double stack was very costly, corrosion was still a serious problem, and proper maintenance of the interior steelwork was practically impossible.

(d) As illustrated, the design here was a slightly tapered steel shaft with the lining self-supporting inside the shell but cut loose from it, and an acid-resisting mortar coating bonded to the steel before erection of the brickwork. Eight cable guys and anchorages were to provide lateral resistance against earthquakes. In the first place, it was impossible to have the stack close to the smelter and still get adequate anchors and cable of equal length, as shown in Fig. 1. A long flue to a distant location would involve a large expense. Furthermore, our experience with guyed stacks in earthquake country had been unsatisfactory, and more than one set of cables might be even worse than the arrangement shown.

(e) Still another idea was the use of a cylindrical steel shell with coating and separated brick lining as described for (d). Stability was to be obtained by using eight trussed steel buttresses attached to the cylinder and the base, with a peripheral bracing system connecting all chords of the vertical trusses. In this design, the temperature of the gases might be well over 1,000 deg F under full operation. The shell would be heated considerably whereas the braces would not be affected similarly. This would tend to overstress the weakest part of the system, or to pull out the bottoms of the braces from their connections to the concrete mat.

(f) Although it seemed fantastic, the next design was an investigation of the idea of supporting the stack on a flexible base so that the stack's inertia would hold it still even if the foundation vibrated laterally. After various attempts, the design evolved into the use of a slightly tapered

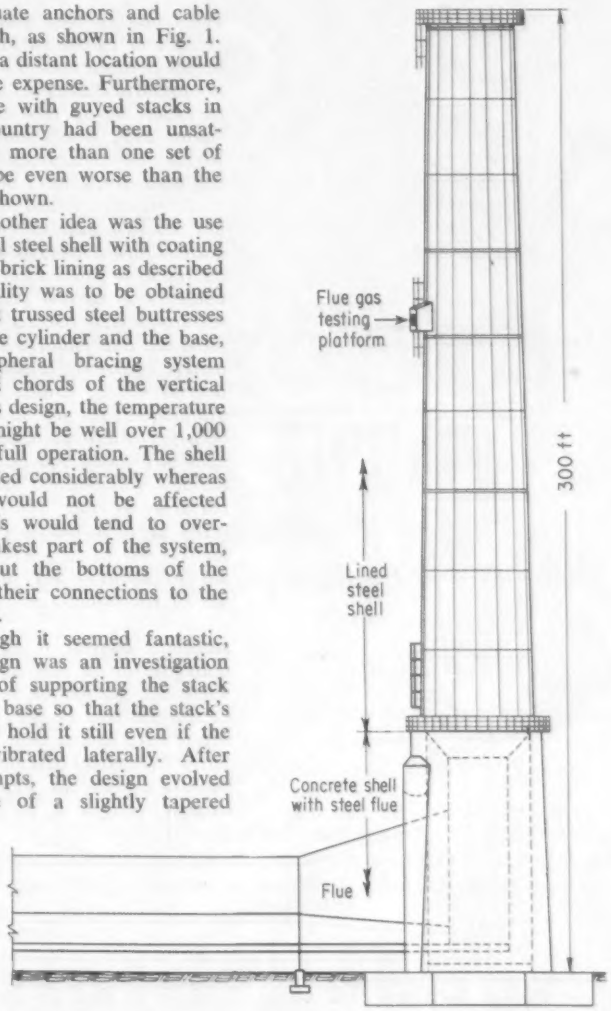


FIG. 3. PURPOSE OF THE FINAL DESIGN was to obtain a structure which would not whip dangerously, and would resist overturing forces during earthquakes.

steel shell, mortar protection for it, and a self-supporting brick lining. The steel base of the shell and lining was suspended on a system of hanger plates supported on the rim of a concrete tank-like structure. However, this design was quickly abandoned because the supporting system should resist shear due to wind but not due to earthquakes—a requirement that could not be met very well. Furthermore, earthquake vibrations could have a vertical component which could cause serious stressing of the suspension system, and the entire structure was too tippy, even under the action of wind alone.

As a result of all these studies it was recommended that a single stack of the proposed dimensions be abandoned and that two 300-ft stacks be built for the initial plant—one for the converters and one for the reverbs—with a second pair to be added when the plant is extended.

The same specifications were to apply to the shorter stacks as to the large one, but the stability was to have as great a safety factor as could be obtained sensibly. The final design is shown in Fig. 3. Each stack consists of a reinforced-concrete pedestal on a heavy mat. The flue comes through a large portal to the conical steel funnel-like terminus supported by its flanged rim resting on bricks on the top of the concrete. Concrete work is ventilated so that heat is no problem. The steel shell of the main shaft is a frustum of a cone having an inside diameter of approximately 24 ft 9 in. at the top. Rigidity is provided with vertical beam and horizontal angle stiffeners. There are no appreciable openings to weaken the steel shaft. Thus the steel shell is very stiff. Vertical splices of the plates are at the beam flanges; the horizontal splices have plates on both sides. Steelwork is riveted. All rivets in inner splice plates are countersunk and the inside heads of others are flattened to 3/16 in. Maximum stress in the steel shaft is 9,000 psi compression. The heavy ring girder at the bottom is connected to the concrete by anchor bolts which can be replaced if necessary.

Estimated period of resonance of the stack is 0.8 sec. The expected period of severe earthquake tremors is thought to be in excess of 1.0 sec.

A temporary brick lining remains in the lower portion of the converter stack only because the gases are so hot that condensation seems to be impossible. The reverb stack is fully lined with 4½ to 13½ in. of acid-proof bricks laid in Sauereisen cement mortar with 3/16-in. layer of this mortar between the bricks and the steel. The converter stack can be fully lined similarly if necessary.

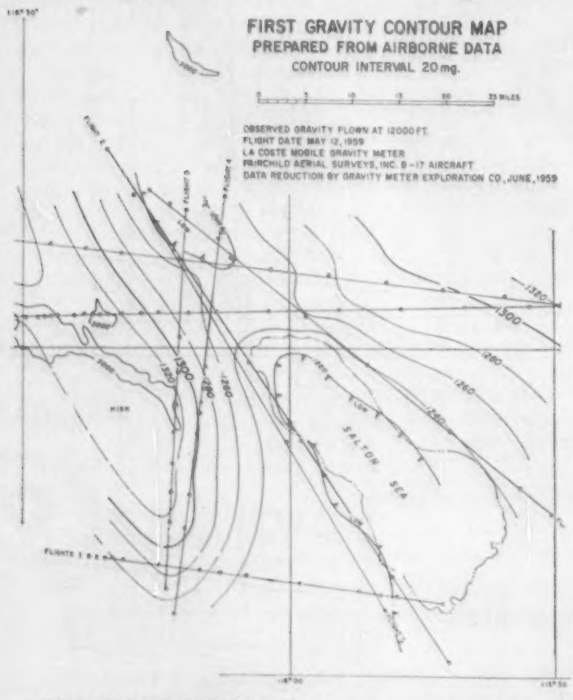
Weight of the steelwork and bricks is approximately 1,430 tons, whereas that of the concrete base and its appurtenances is 6,805 tons. The center of gravity of the assumed seismic forces is 65 ft above the bottom of the mat. Safety factor against overturning for dead load plus earthquake is 4.92. Maximum soil pressure at one edge of the entire base is approximately 7,500 psf, and the minimum pressure under the opposite edge is slightly more than zero.

Basic purpose of the design is to obtain a structure which cannot whip dangerously, which has no weak spots subjected to high alternating stresses, and which has its center of gravity so low that its own weight provides a tremendous righting tendency when any forces try to tip over the struture.

Preliminary designs were made by Arthur L. Otto, Edward Powell, and others of Anaconda-Jurden Associates, Inc. staff. The final design was made by Louis A. Warner under the guidance of A.B. Piver. The author was in general charge of the planning and design.

1. "Mining Engineering," Dec. 1952.

A Geophysical Breakthrough—the Airborne Gravity Meter

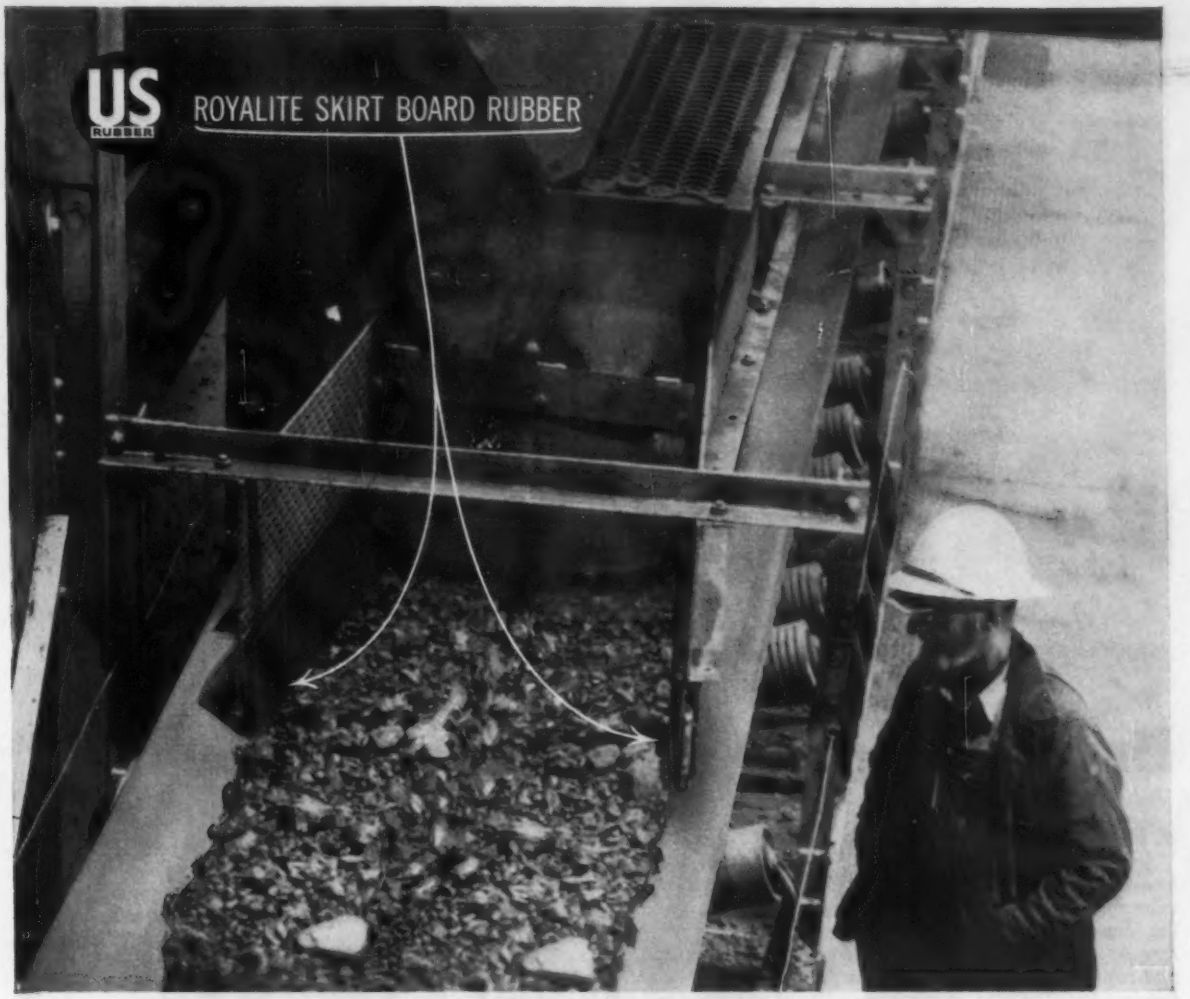

FIRST GRAVITY CONTOUR MAP
PREPARED FROM AIRBORNE DATA
CONTOUR INTERVAL 20 mg.
OBSERVED GRAVITY FLOWN AT 12000 FT.
FLIGHT DATE MAY 12, 1959
LA COSTE MOBILE GRAVITY METER
FAIRCHILD AERIAL SURVEYS, INC. B-17 AIRCRAFT
DATA REDUCTION BY GRAVITY METER EXPLORATION CO., JUNE, 1959
SALTON SEA

AIRBORNE GRAVITY MAP for area over Imperial Valley.

Successful tests with the airborne gravity meter, flown by Fairchild Aerial Surveys, Ltd., over Imperial Valley, Calif., constitute a geophysical breakthrough. The map, at left, shows variations in the earth's gravitational field over the test area. Gravitational contour intervals are expressed in milligals. A "gal" is a unit of acceleration due to gravity expressed in cm per sec per sec. Normal intensity of the gravitational field at the earth's surface is 980 gal. The milligal (mg) unit used on the accompanying map is 1/1,000 gal.

Heretofore use of the gravity meter on aircraft was not successful because of the relatively large forces imposed on the meter by the motion of the plane. Corrections of 1,000 to 1,200 mg have to be made to compensate for motion when a plane is flying at 200 mph. Refinements in technique to correct for plane speed and other factors accounted for the success of the recent tests. Scientists who participated in the work included Dr. Lucien LaCoste, co-inventor of the LaCoste-Romberg gravity meter used in the test, and Dr. L. J. Nettleton, world-famed geophysicist.

General E. M. Day, president of Fairchild surveys, announced that Fairchild-LaCoste Gravity Surveys Co. would be formed to undertake work in this field. First applications will be in the mapping of the earth's surface and in developing gravity data for guided missile flight. Later, with refinement, General Day predicted that the airborne gravity meter would be used on slow planes or helicopters to explore for ore and mineral deposits.



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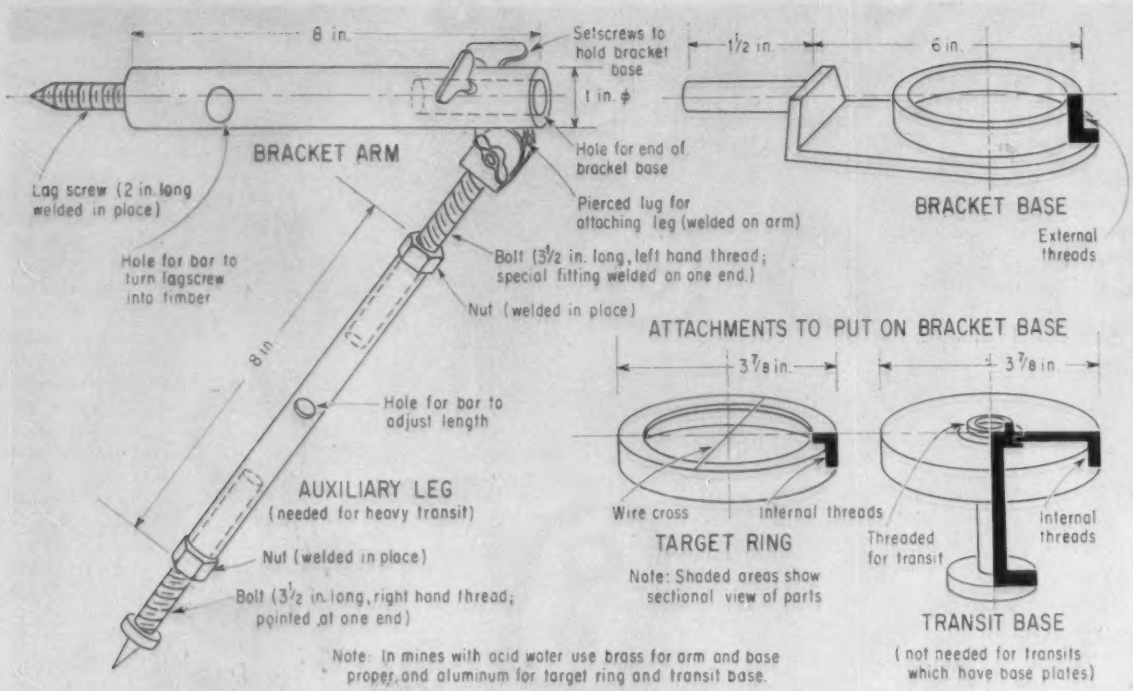

8 in.
Setscrews to hold bracket base
1 in. ϕ
BRACKET ARM
Lag screw (2 in. long welded in place)
Hole for bar to turn lagscrew into timber
Hole for end of bracket base
Pierced lug for attaching leg (welded on arm)
Bolt (3½ in. long, left hand thread; special fitting welded on one end.)
Nut (welded in place)
8 in.
Hole for bar to adjust length
AUXILIARY LEG
(needed for heavy transit)
Nut (welded in place)
Bolt (3½ in. long, right hand thread; pointed at one end)
1½ in.
6 in.
BRACKET BASE
External threads
ATTACHMENTS TO PUT ON BRACKET BASE
3⅞ in.
3⅞ in.
Wire cross
Internal threads
TARGET RING
Note: Shaded areas show sectional view of parts
Threaded for transit
Internal threads
TRANSIT BASE
(not needed for transits which have base plates)
Note: In mines with acid water use brass for arm and base proper, and aluminum for target ring and transit base.

Bracket Improves Raise Surveying

J. H. VALKENHOFF

SIMPLER, MORE ACCURATE AND FASTER raise surveys have resulted from using the inexpensive bracket arm assembly shown above. It was locally made and required only normal precision in fabrication. The one shown was designed for a Kern DKM-1 theodolite but similar brackets can be made to fit any transit. Although the lagscrew on the arm was designed for timbered openings, a short expansion-shell rockbolt could be used in its place for unlined workings. The auxiliary leg or brace may be omitted if the transit is lightweight. Such brackets may often be used to advantage in level surveys too.

In surveying, three brackets are used (see drawing at right). The arms are screwed into place to serve as transit station, backsight and foresight. The bracket bases are slipped into the bracket arms and held by the thumbscrews. All bases should be horizontal in raise work but on a level the sight bases are set vertical. Target rings are screwed onto the bases at the sight points. The transit is screwed on to the special transit base if necessary, and then screwed onto the bracket base on the arm at the transit station. Transits having their own base plates must be centered thereon and remain so by careful leveling and handling during the entire survey. They can be screwed directly on the bracket base. The instrument height above the base is, of course, considered a constant.

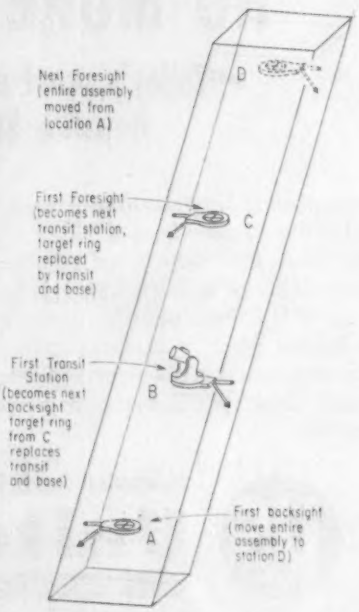
After the angles and slope distances are measured and recorded, the transit and transit base is interchanged with the foresight target ring, and the entire backsight bracket arm assembly is moved to a new foresight.

The stations are not permanent for as soon as the bracket is removed the station is lost. However, by placing a spad above the center of the target the station may be preserved.

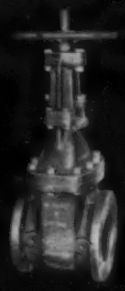
Under operating conditions, this raise surveying method has cut time per station and has improved the operation in other ways:

1. setting up and centering the transit is greatly simplified;
2. the setup is not as easily disturbed as when a tripod is used;
3. no plumb bobs are used so air currents have no influence;
4. sighting is done at the survey points proper;
5. distances are measured directly to fixed points;
6. the surveyor works in a less confined space under more comfortable conditions.

The accuracy of the surveys, as expressed by: $e=\frac{\sqrt{x^2+y^2}}{L}$ where x and y denote the closure errors in the coordinates and L is the total slope distance measured, was found to easily approach 1:3,000.


Next Foresight (entire assembly moved from location A)
D
First Foresight (becomes next transit station, target ring replaced by transit and base)
C
First Transit Station (becomes next backsight target ring from C replaces transit and base)
B
A
First backsight (move entire assembly to station D)

Mr. Valkenhoff, presently with Surinam Aluminum Co., Paramaribo, Surinam, originated the scheme and apparatus described above while chief engineer at a property in Peru.



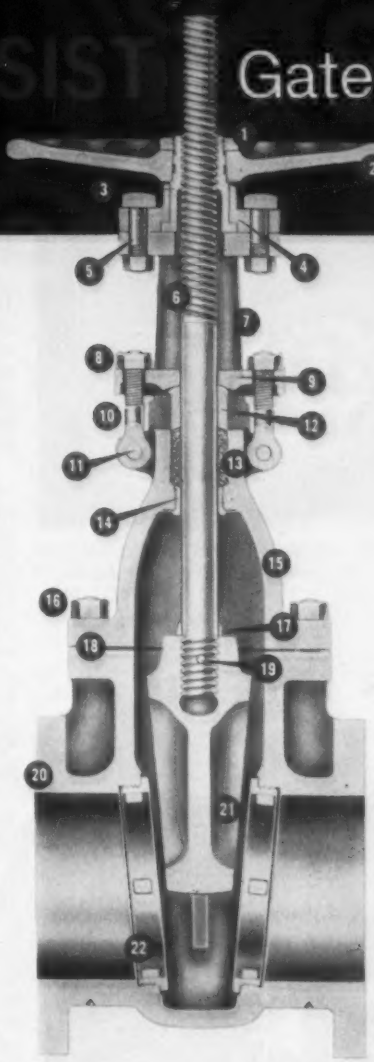
You extend valve life in Corrosive and Erosive services TWO WAYS when you Specify JENKINS for NI-RESIST Gate Valves, too

No. 1 ... when you specify "Jenkins" you get not merely "Ni-Resist" metal but you get Type 2 Ni-Resist Cast Iron! That affords extra resistance to acids, salt and alkaline solutions, sea water, brine and other corrosive and erosive fluids, vapors or gases. It is copper-free and will not contaminate or discolor the materials controlled.

Type 316 Stainless Steel is used for the wedge, spindle and other trimmings to give you a combination of metals which have remarkable ability to withstand destructive service.

No. 2 ... you get all the excellence which the Jenkins Diamond trademark has represented for nearly a century. The superior design and construction are visible here. Equally important superiorities which show up only in the records of long service and low maintenance are the close grain and high density of Jenkins castings ... the precision of Jenkins machining ... the rigid inspection and testing which every Diamond-marked valve undergoes.

It costs no more to buy Ni-Resist Gates made by Jenkins. And, it may cost much less to USE them. Write us, or ask your Jenkins Distributor for information folder No. 205.



1 Bronze yoke bushing nut
2 Handy grip iron wheel
3 Bronze yoke bushing
4 Iron yoke cap with zerk fitting for lubricating bushing
5 Steel yoke cap bolts and nuts
6 TYPE 316 STAINLESS STEEL spindle
7 NI-RESIST CAST IRON, TYPE 2, yoke
8 Bronze eye bolt nuts
9 Malleable iron gland flange
10 Steel gland eye bolts
11 Steel gland lug bolts and nuts
12 TYPE 316 STAINLESS STEEL gland
13 Teflon impregnated asbestos packing
14 TYPE 316 STAINLESS STEEL bonnet bushing
15 NI-RESIST CAST IRON, TYPE 2, bonnet
16 Steel bonnet bolts and nuts
17 TYPE 316 STAINLESS STEEL spindle ring
18 Asbestos gasket
19 TYPE 316 STAINLESS STEEL wedge pin
20 NI-RESIST CAST IRON, TYPE 2, through-port body
21 TYPE 316 STAINLESS STEEL solid I-beam wedge
22 TYPE 316 STAINLESS STEEL seat rings

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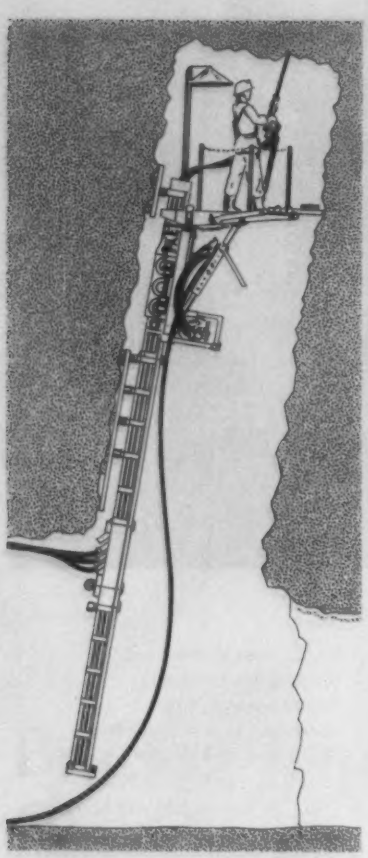
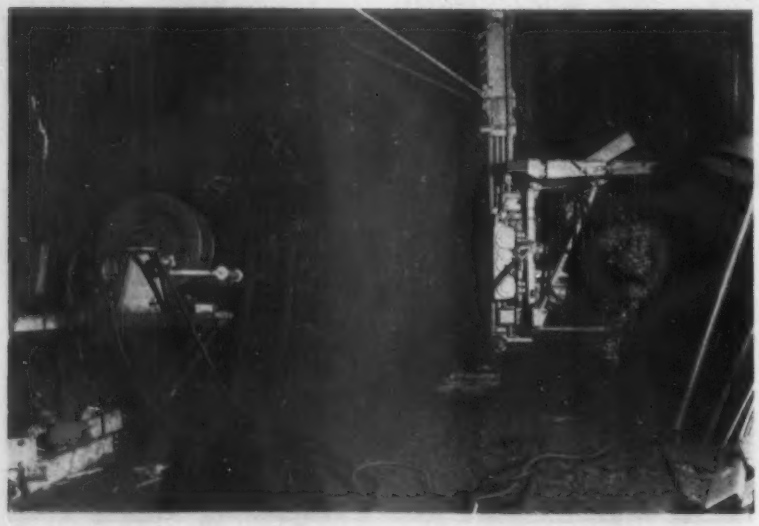


PLATFORM with integral motor is moved by cogwheels along sectional notched monorail which is rockbolted to wall of raise or erected as tower on transporter.

Elevator Eases Raising



REEL in niche at base of raise feeds out powerline to platform motor in ascent. Bottom rail section is hinged so platform can be swung under brow during blasting.

VERTICAL AND INCLINED RAISES, as well as those of irregular alignment, are being driven with greater ease, safety and speed through the use of a monorail platform elevator developed and manufactured by Alimak-Verken AB in Skelleftea, Sweden. Units have been test-proven at a number of Scandinavian mines and several units have been delivered to mines in Britain and North America.

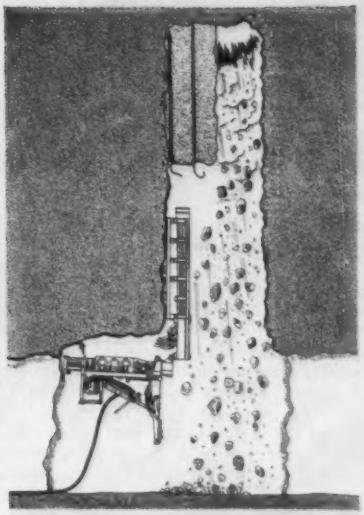
Installation of the equipment in a raise is very simple and there is no limit to the length of raise that can be driven so long as sufficient air and/or electricity can be delivered to the platform. However, to use present models, a minimum cross-section of 6½x6½ ft is needed. The unit can also be used as a mobile platform for reaching high places.

Use of the elevator in raising completely eliminates climbing as well as carrying equipment. Timbering may also be eliminated if not needed for ground support, in which case ventilation is improved by the absence of obstructions to flow. Overhead protection to the miner is excellent. Speed of raising has been reported increased as much as 50% and, as compared to cage-raising, no initial hoisting-rope hole is needed.

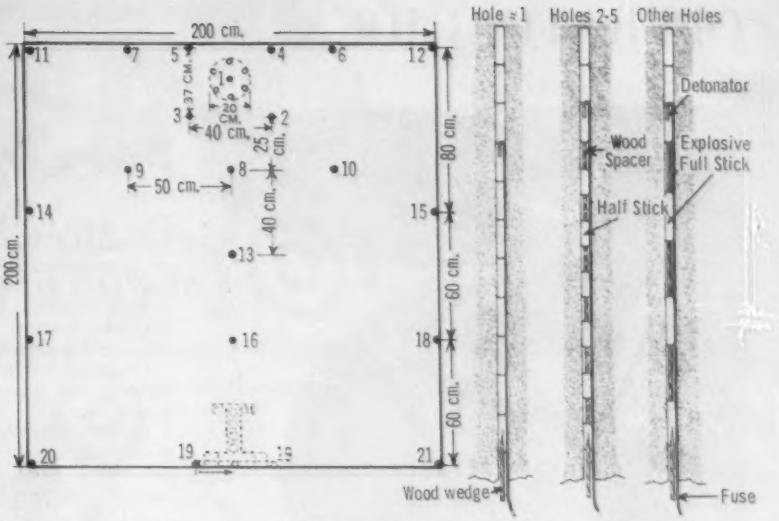
Apparatus consists of a platform which moves on a sectional notched rail. The platform is powered by an integral air or electric motor and gear train. Air or electricity is supplied through a hose or cable fed off a reel on the floor of the opening. The guide-rail assembly contains air and water lines for drilling and fume flushing. A three-wheel wagon is used to transport the 1100-lb elevator to the work site and also serves as a mount for the elevator up to moderate heights. For long raises, guide-rail sections are fastened to a wall by short expansion-shell rockbolts. Guide-rails and rockbolts are recovered for reuse.

The 63-in. square deck is a heavy-gage plate, welded-box construction, with holes for mounting drills, safety railing and a pipe standard bearing a cone-shaped hood for warding off rock falls when scaling. Struts underneath the deck adjust to fit the inclination of the raise. Also below deck there are containers for drills and tools, a hand winch for hoisting-up equipment and supplies, a collapsible driver's seat and the driving motor and reduction gears. The platform assembly is six ft high. The deck folds in half and the unit can be further disassembled rather easily as needed for moving. For steep raises, a hinged platform is offered.

The platform can move at 33 fpm up or 50 fpm down, carrying a maximum payload of 1,100 lb, when



BLASTING in raise should be designed to prevent any damage to rail assembly.



SUGGESTED BURN-CUT ROUND has 27 parallel holes except that No. 19 is drilled at slight angle from alternate sides of rail so that midpoint is on line.

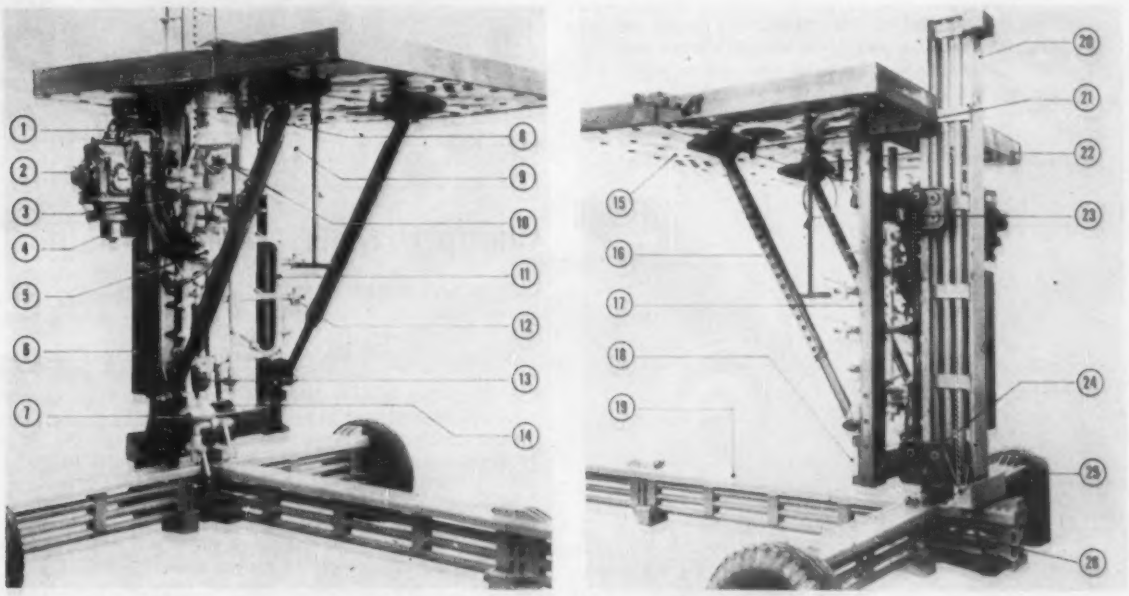
equipped with a 6.2-hp, 1,000-rpm Atlas Copco air motor. Worm gears on the elevating mechanism are self-locking but in emergency a hand crank is available for lowering the platform on the rail.

The guide-rail is available in one- and two-meter lengths, weighing 27 or 54 lb, with special curved and hinged sections for direction changes. The rack or notches are in the protected location on the underside of the head on one side of the web. The web contains four 1½-in. pipes for air and water supply to the deck. A special head-box fits over the top end of the guide-rail and contains valves and outlet fittings for air and water as well as connections for electric firing and lighting lines. The cover of the box protects the rail end from flyrock damage during blasting and has an air-water mixing spray nozzle which is used to clear fumes. Each rail section has a bracket for attaching it to two rockbolts.

Once rails are rockbolted in place, a hinged section is used at the bottom of the raise so that the platform can be swung under the brow during blasting. This first section is often concreted in place for stability.

Auxiliary equipment includes special climbing tools and a lifeline for climbing the guide-rail if power fails. Telephones are also installed.

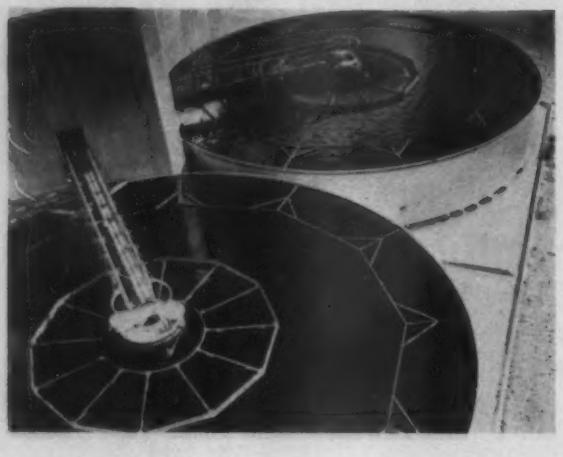
At Boliden base-metal mines in Sweden some 400-ft raises were cut and in Finland a 570-ft raise is being driven, using the unit. Kiruna iron in Sweden has also used it successfully.



LATEST MODEL has been streamlined, with few frills and very compact design of various components:

1. exhaust pipe to muffler and rail lubricator; 2. air motor; 3. air cleaner on inlet from top of rail; 4. drive chain; 5. valve and brake; 6. driving gears; 7. air cleaner on inlet from reel; 8. air floodlight; 9. oil hose; 10. anchor chain; 11. air and water central; 12. air tap for drill; 13. lubricator; 14. air hose to clean rail and rollers; 15. hinged outer platform; 16. strut; 17. frame; 18. seat bracket; 19. transporter built from rail; 20. heavy bottom rail; 21. clamp plate; 22. platform, interior oil tank; 23. automatic safety brake; 24. guide roller; 25. wheel; 26. bolt for inclining rail.

OPERATING IDEAS



Baffles Reduce Froth and Waves

TWO BAFFLE ARRANGEMENTS have helped control foam accumulation and wave build-up in two 75-ft dia thickeners at Homestake-New Mexico Partners' Grants, New Mexico mill.

Both radiating froth baffles have 30-ft diameters and the perimeter-mounted wave baffles were installed to combat the effect of high winds common to the area.

Foreground unit clarifies pregnant liquor from the refinery, leaching and filtering system. Second unit thickens grinding circuit slurry.

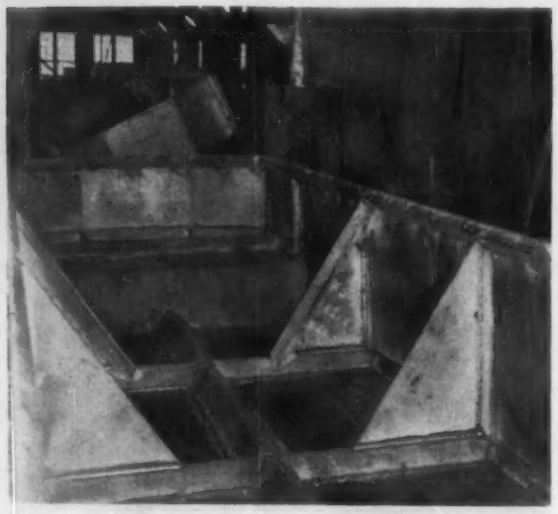
Clarified overflow goes to precipitation step while that overflowing the slurry thickener returns to the grinding circuit for reuse. Thickened pregnant liquor goes to the mill's carbonate leach circuit.

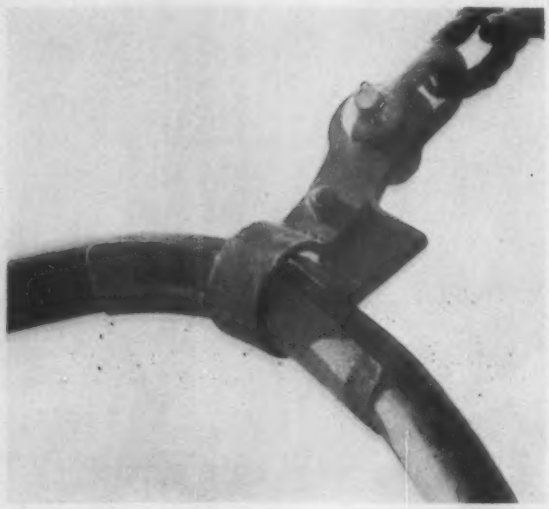
All-Welded Car Hauls 15 Tons

LARGE, ALL-WELDED MINE CARS have been put into service at Hanna Coal Co.'s Ireland Mine.

The eight-wheel cars (Watt Car & Wheel Co., Barnesville, Ohio) weigh six tons apiece, are 48-in. high, 84-in. wide and have an inside length of 26 ft. Ireland's 600 cars each hold 543 cubic ft, or approximately 15 tons of coal. The trucks are miniature railroad type, using 16-in. wheels fitted with Timken roller bearings. The sides and ends are $^{5}/_{16}$ in. high tensile steel; the bottom and supporting members are $^{3}/_{8}$ in. high tensile steel.

There are 1400 ft of welding on each car, mostly fillet welds, ranging in size from ¼ in. to ¾ in. Large iron powder electrodes put in the larger welds on flat joints. Some conventional electrodes were used for uphill and vertical work where more fast freezing was needed. Standard Lincoln 500 amp Idealarc combination ac and dc welding machines were used (Lincoln Electric Co., Cleveland, Ohio).





Clamp Protects Hanging Cable

ONE OF THE PROBLEMS of handling trailing power cables of electric shovels and other equipment is that of hanging them over haulage roads.

At National Lead Co.'s MacIntyre Development open pit, Tahawus, N.Y., masts were placed at each side of the road. The masts had sheaves near the top to hold ¾-in. manilla rope. One end of each rope was attached to the power cable.

Until recently, the rope was clove hitched to the cable. At this knot, the cable would bend, take a set and sometimes suffer internal damage.

Now, however, a special clamp (designed and built by William Bertsch, welding and millwright foreman) enables the cable to be attached without effort and to be hoisted without very much chance of getting damaged.

The clamp's fixed side is bent to form an easy arc on which to place the cable. When hoisting begins (see photo), the movable part of the clamp is leveraged tightly against the cable—the heavier the cable, the more tightly it's held.

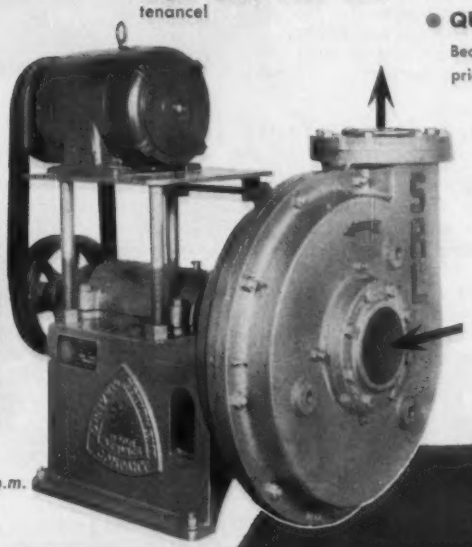
Here are the INSIDE REASONS why

DENVER SRL PUMPS

- wear up to 15 times longer...
- save up to 50% in horsepower!

DENVER SRL PUMPS
cost less, last longer...

... ***because*** casing liners and runners are tough rubber, pressure-molded to steel for longest wear, lowest maintenance!



Capacity to 3000 g.p.m.

● RUBBER MOLDED TO STEEL

Runners and casing liners are tough, abrasion-resistant rubber pressure-molded to close tolerances over steel skeletons and backing plates. This gives necessary rigidity and provides precision fit of parts for high pumping efficiency. Rubber covered parts last up to 15 times longer than the best hard iron or alloy steel. Means fewer shutdowns...lower maintenance.

● HIGH EFFICIENCY...LOW HORSEPOWER

Precision fit of parts and hydraulic efficiency result in savings as high as 50% in horsepower over other sand and slurry pumps.

● SIMPLE CONSTRUCTION

DENVER SRL Pumps have few parts, rugged design. Available in either sealing water type or with mechanical shaft seals, open or closed runner. Also available with alloy metal runners or in special construction for corrosive solutions.

● QUANTITY PRODUCTION MEANS LOW COST

Because of quantity production, DENVER SRL Pumps are now priced low—so low that no operator can afford any pump service less than that of DENVER SRL Pumps.

PARTS COST LESS, TOO!

Parts cost less and last longer for even greater economy. All DENVER Pump parts are carried in stock for quick delivery. Fast replacement parts service reduces your inventory requirements.

Learn how DENVER SRL Pumps can save money for you. Write for recommendations and prices!

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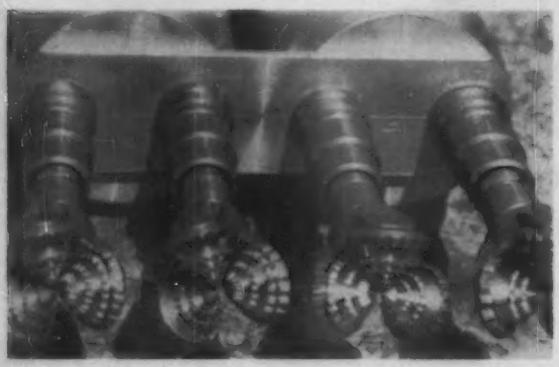
OPERATING IDEAS *(Continued)*



Turbo-Drills Form Shaft Borer

MULTIPLE MUD-ACTUATED-TURBINE DRILLS fitted with roller cone bits are the basis of a shaft borer recently developed in the Soviet Union. Earlier E&MJ reports have described the unit as being a barrel-like frame which rotates and has independently-rotating roller-cone mud-turbine drills mounted on a radial arm. This photo, released in July, shows a somewhat different frame and may be an altogether different design. According to "Die Sowejetunion Heute," a weekly magazine published by the Soviet Embassy in Bonn, Germany, the four cutter heads are each 23 in. or more in diameter and rotate simultaneously to cut auxiliary and ventilation shafts from 2½ to 26 ft in diameter. In the U.S., Hughes Tool Co. has developed a similar tunnel and shaft borer (see E&MJ June 1959 p 216).

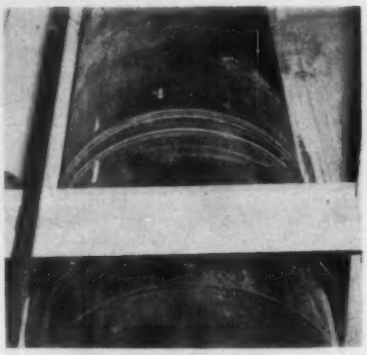
Ultra Smooth-Walled Wooden Piping is Gold Mine's Air Duct

FOUL AIR WILL BE EXTRACTED from the underground workings of a South African gold mine through wooden piping for the first time in the modern history of the industry, according to McGraw-Hill World News's Johannesburg office.

The staff at Free State Saaiplaas, one of the mines in the New Consolidated Goldfields group, decided to use wood to counter the corrosive action of the goldfield's saline water which is particularly damaging to galvanized ducting.

The mine's No. 2 shaft is 27.5 in dia and is one of the largest in the world. It is approximately 6500-ft deep and is being equipped with the permanent shaft steelwork and 48-in. wooden pipe in 15-ft lengths. The 60-in. dia pipe, which is being made in 30-ft lengths, will be installed after the shaft is completely equipped with the steelwork.

The birch plywood ducting (made by Ventilation-Ducting Ltd., Welkom) undergoes a special bakelising process and is then subjected to heat and pressure. The entire process prevents mold growth and makes the ducting resistant to any water action. Duct surface then gets a high-gloss finish and this, combined with the type of joint used, reduces friction loss to well below that experienced in the conventional type of ducting and allows more air to pass through than in other type tubing of the same diameter.



How to Seize Wire Rope and Attach it Securely to Sockets

THE FOLLOWING HINTS on how to seize wire rope and how to attach it to steel sockets appeared in LeTourneau-Westinghouse's magazine, THE CO-OPERATOR.

According to L-W, seizings should be placed on both sides of the work area before the wire rope is cut. Failure to seize or to seize properly permits the strands to untwist, which may form an unbalanced condition in the rope and cause its service life to be reduced.

Seizing wire should be an annealed low carbon grade. In seizing ropes of 1-in. dia and smaller, hand cutters should be use to tighten the seizing wire. For larger ropes, a seizing iron or iron bar is recommended.

A good seizing operation, L-W says, is done in the following manner.

1. Wind the seizing wire or strand around the wire rope tightly as possible.

2. Twist the ends of the seizing wire together (counter-clockwise), so that the twist is near the middle of the seizing.

3. Using cutters, tighten the twist just enough to take up the slack. Do not try to tighten the seizing by twisting.

4. Tighten the seizing by prying the twist away from the axis of the wire rope with cutters.

5. Repeat the tightening procedures as often as necessary. Cut off the ends of the wires and pound the twist into contact with the seizing.

The second part of Co-Operator's presentation—how to attach sockets to wire rope—was outlined in these eight steps.

1. From the end of a securely seized rope, measure a length equal to the basket of the socket and put not less than three seizings at this point.

2. The end seizing on the wire rope should be taken off, leaving the Step 1 seizing intact. The fiber core should be cut back to this seizing, and the wires should be untwisted and broomed. Do not cut out independent wire rope center or strand center when they are used as a core.

3. The wires, for the distance that they are to be inserted in the socket, should be carefully cleaned with benzine, naphtha, or gasoline. They should be dipped in a muriatic acid solution (50% commercial muriatic acid and 50% water) up to about three-quarters of the distance to the first seizing. Dipping should take about one minute or until the acid has thoroughly cleaned each wire. Maintain acid at strength given and do not allow oil to collect on the surface. Be sure that the acid does not come into contact with any other portion of the rope. If it does, the wire will become brittle.

4. The acid should be neutralized by next dipping the wires into boiling water to which a small amount of soda has been added.

5. Now draw the ends of the wire together with a piece of seizing wire so that the socket can be forced down over them. Warm the socket and slip it over the wires. Cut the seizing holding the ends of the wires and distribute the wires evenly in the basket and flush with the top.

6. Seal the base of the socket with putty, or any other similar substance. Pour molten zinc into the socket basket until it is full.

7. Use only high grade zinc at a temperature of 800° to 850° F. The zinc should not be too hot or it will anneal the wires, particularly in small wire ropes. If the zinc is at the proper temperature, a soft pine stick dipped into it and quickly withdrawn should not have any zinc adhering to it and should only be slightly discolored by scorching.

8. Remove all seizings except the one nearest the socket. After cooling slowly, th socket is ready for service.

By following the outlined method, CO-OPERATOR stated, the socket will develop 100% of the breaking strength of the rope —a rope tested to destruction will break before it will pull from the socket.

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Extra—A combination of properties which permits operation with copper temperatures up to 90° C.

WHAT'S NEW IN U.S. PATENTS

OLIVER 5. NORTH

Exploration

Airborne electromagnetic method and apparatus for establishing the existence of a subsurface conducting ore zone, especially a sulphide orebody. A primary alternating flux field is set up in the region of the orebody and the resultant voltage induced in a pick-up coil is measured. K. A. Ruddock and A. A. Brant, assigned to Newmont Mining Corp. No. 2,887,650.

Design for a mineral separator adapted to separate automatically the mineral particles from water- or airborne cuttings from a drill hole. Apparatus has a series of concentric conical baffles; as the cuttings change direction the mineral particles drop out, and are available to be quickly analyzed. C. E. Batterson. No. 2,884,134.

Mining

For the drilling of rounds during shaft or sump sinking, a support or post centered in the pilot hole has one or more adjustable extensible jib arms for supporting drills at predetermined points. Inaccurately drilled cuts and resultant unsuccessful shot falls are avoided. W. Duda. No. 2,884,701.

Construction of a percussion drill bit having four cutting inserts fitted and brazed in slots in the head support. Two of the inserts are longer than the other two. D. S. Saxman, assigned to Kennametal, Inc. No. 2,879,973.

Metal and Mineral Processing

Design for a dry gravity separator for recovering free gold or gold-bearing pieces from sands or crushed ore. D. A. Herron, assigned to Colorado Dry Concentrator Co. No. 2,885,077.

In the recovery of mica from river silt deposits, a 4 to 80-mesh fraction is separated by screening and deslimed, conditioned, and subjected to froth flotation to produce an overflow mica concentrate. D. H. Fenske, assigned to International Minerals & Chemical Corp. No. 2,885,078.

Apparatus for feeding finely divided iron ore to a furnace, whereby the ore receives a high initial heat. Time required for reduction of ore is considerably shortened. W. A. Patterson, assigned to Fort Pitt Bridge Works. No. 2,885,199.

Construction for a series of inclined benches adapted for the cooling of iron ore sinter. W. C. E. Ball and F. L. Smith, assigned to Dorman Long (Steel) Ltd. No. 2,885,200.

Iron ore sinter cooling grate having an integral manifold for maintaining the grates in relatively cool condition and thereby preventing adherence of the sintered material and resulting undesirable build-up. S. T. Evenstad. No. 2,885,201.

Process for removing zinc contaminants from sodium aluminate liquors obtained in the preparation of alumina from bauxite by the Bayer process. Dissolved zinc is precipitated with sodium sulphide. E. W. Adams and R. L. Jeansonne, assigned to Kaiser Aluminum & Chemical Corp. No. 2,885,261.

To recover uranium, the ore is subjected to countercurrent extraction at high temperatures with an aqueous solution of sodium bicarbonate, and the resulting extract acidified, purified of carbon dioxide and alkalinized, and the precipitated uranium recovered therefrom. J. C. Karcher and F. J. Allen, Jr., assigned to Concho Petroleum Co. No. 2,885,270.

In the reduction of ilmenite, the ore is first partially reduced in the solid state and the resulting mass then completely melted, forming two fluid beds, the lower being ferrous metal and the upper a slag rich in titanium dioxide. A. Greffe, assigned to Societe d'Electro-Chimie d'Electro-Metallurgie et des Acieres Electriques d'Ugine. No. 2,885,280.

COPIES of U.S. patents can be purchased at 25c each from Commissioner of Patents, Washington 25, D. C.

Method and apparatus for controlling the density of a mixture of crushed nonferrous ore and water, using bubble pipes arranged at a point in the pulp where the solids content is constantly representative of the entire mass. A. F. Kroll, K. E. Atwood and F. H. Mehle, assigned to Bailey Meter Co No. 2,886,-051.

Improved shock-chilling condenser for condensing zinc as liquid from zinc vapor in which liquid lead is used as a circulating medium. Dross is withdrawn by an inclined conveyor which permits the liquid lead to drain back into the condenser. L. J. Derham, assigned to Metallurgical Development Co. No. 2,886,051.

In the treatment of columbium-tantalum ores to recover the metals, the ground ore is digested with ammonium fluoride after being roasted, and the resulting soluble columbium and tantalum fluorides separated from the complex fluoride residue and treated separately for recovery of the two metals. A. T. McCord. No. 2,888,320.

Pulverulent beneficiated taconite or other low-grade iron ore is mixed with a natural brine of $CaCl_2$ and/or $MgCl_2$ and briquetted or pelletized to produce a stronger furnace-grade material than when clay or inorganic cement is used as the binder. Lower agglomerating temperatures are possible using these chloride brines. R. M. Lawless and A. F. Klopf, assigned to Dow Chemical Co. No. 2,888,341.

Design for an improved ore screening and grading apparatus in which a given screen may be readily adjusted to separate ore particles of a desired size. M. Romera. No. 2,879,890.

Method of separating columbium and tantalum values from mixed ores or concentrates. Material is mixed with an alkali metal acid fluoride, (KHF_2) and heated to convert the columbium to a water-soluble complex fluoride and the tantalum to a less soluble complex fluoride. N. L. Campbell and R. C. Vickery, assigned to Horizons Inc. No. 2,880,060.

Acid leach process for producing $FeCl_2$ and $FeSO_4$ from siderite, limonite, and hematite ores. A substantially carbon-free sponge iron and/or iron powder can be produced from the $FeCl_2$ and $FeSO_4$. C. B. Francis, assigned to Puriron & Chemicals, Inc. No. 2,880,062.

In the production of sponge iron, the coal and lime are mixed together separately, and the resulting coated fuel mixed with the ore prior to starting reduction operations. Method prevents sulphur from entering the sponge iron product. F. O. Wienert, assigned to R-N Corp. No. 2,880,083.

An improved method and apparatus is described for the sink-float separation of minerals from gangue. A high velocity air stream is introduced adjacent to the float product overflow, thus immediately segregating a large portion of the float and thereby substantially reducing the circulating float load. H. L. McNeill. No. 2,880,869.

Design for a shaft kiln for reduction roasting of manganiferous iron oxide ores to produce Fe_3O_4 and MnO. Objectionable dead-burning of the MnO is avoided. B. R. Babbitt and C. B. Kunz, assigned to Manganese Chemicals Corp. No. 2,880,988.

Method for reducing or eliminating the silica content of crude magnesite. The crushed ore is subjected to sudden contact with a hot gas, causing explosive disintegration of the mineral and entrainment of the silica particles in the effluent gas. E. Bieneck and E. Schroth, assigned to Didier-Werke A.G. No. 2,-881,048.

Two-stage method for drying phosphate rock prior to electrostatic beneficiation thereof. C. C. Cook, assigned to International Minerals & Chemical Corp. No. 2,881,916.

Design for an apparatus for use in the hand-picking of ores, particularly feldspar and other ores containing quartz and like gangue materials whose physical characteristics are similar to those of the contained mineral. E. W. Windolph. No. 2,883,050.

Mr. North is patent consultant, Washington, D.C.

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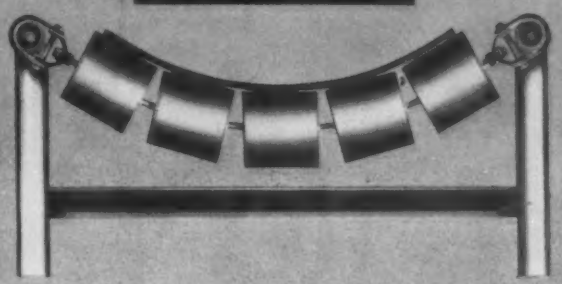

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NEW BOOKS

Foreign Pamphlets

Bulletin No. 6, The Gypsum Deposits of Western Australia, by L. E. de la Hunty and G. B. Low. Published by the Dept. of Mines, Mineral Resources of West Australia Perth. Maps, plates and 107pp.

Bulletin No. 111, The Exploratory Diamond Drilling of The Koolyanobbing Iron Deposits For Pyrite, by H. A. Ellis. Published by Western Australian Geological Survey, Perth. Maps and 140pp.

Bulletin No. 1, Geology of North Tailevu Viti Levu, by R. E. Houtz. Published by the Geological Survey Dept., Suva, Fiji. Map, illustrations and 19pp. Price 10s.

Economic Bulletin No. 1.1, Airborne Magnetometer and Scintillation Counter Survey Over Parts of Perak, Selangor & N.S. (Area 1), by W. B. Agocs with Geology by J. R. Paton. Extract from the Colombo Plan report. Published by Geological Survey, Ministry of Natural Resources, Federation of Malaya, IpoH. Price $5 (Malayan).

F. L. Stillwell Anniversary Volume published by the Australian Institute of Mining & Metallurgy honors Dr. Stillwell on his 70th birthday and contains sixteen recent articles on geology of Australia. Published by the Institute, 399 Little Collins St., Melbourne, Australia. Maps, plates and 301 pp. Price unlisted.

Bulletin No. 110, The Geology of the Phillips River Goldfield, W. A., by John Sofoulis. Published by Western Australian Geological Survey, Perth. 233pp with one plate and 17 figures, and 16 plates in separate atlas.

Bulletin No. 34, Regional Geology and Mineral Resources of the Olary Province, by B. Campana and D. King. Published by South Australian Dept. of Mines Geological Survey, Adelaide. Maps, plates and 133pp. Price 7s 6d.

Boletim No. 177, Bibliografia e Indicie da Geologia do Brasil (1951-1955), by Dolores Iglesias e Maria de Lourdes Meneghezzi. Published by Divisao de Geologia e Mineralogia, Rio de Janeiro, Brazil. Index and 69pp. In Portuguese.

Boletim No. 164, Bibliografia e Indice da Geologia do Brasil (1945-1950), by Dolores Iglesias e Maria de Lourdes Menehezzi. Published by Divisao de Geologia e Mineralogia, Rio de Janeiro. 107pp and index. In Portuguese.

Bulletin No. 58, The Geology of the Eglinton Valley, Southland, by G. W. Grindley. Published by New Zealand Dept. of Scientific & Industrial Research, Geological Survey, Wellington. Maps, illustrations and 64pp Price 20s (paper); 25s (quarter cloth).

Bulletin No. 60, Regional Metamorphism in South-East Nelson, by J. J. Reed. Published by New Zealand Dept. of Scientific & Industrial Research, Geological Survey, Wellington. Illustrated in 60pp. Price 12s 6d (paper); 17s 6d (quarter cloth).

Report No. 42, Geology of the Derkali-Melka Murri Area, by A. O. Thompson. Published by Geological Survey, Colony and Protectorate of Kenya, Nairobi. Maps, illustrations and 35pp. Price 15s.

Report No. 42, Geology of the Magadi Area, by B. H. Baker. Published by the Geological Survey, Colony and Protectorate of Kenya, Nairobi. Maps, illustrations and 81pp. Price Sh. 17/50.

Geological Circular No. 8, Pleistocene Geology of the Hamilton Map-Area, by P. F. Karrow. Published by Ontario Dept. of Mines, Toronto. Map and 6pp.

Memoir No. 291, Mount Head Map-Area, Alberta, by R. J. W. Douglas. Published by Canadian Dept. of Mines & Technical Surveys, Geological Survey, Ottawa. Maps, plates, illustrations and 237pp. Price $2.

New Horizons in 1958—the annual report of the Ontario Dept. of Mines, Toronto. Illustrated in 144pp.

Primary Iron & Steel Metallurgical Works in Canada, January 1958. Lists companies, operations, equipment and production data. Published by Dept. of Mines & Technical Surveys, Mineral Resources Division, Ottawa. 35pp. Price 25c.

Economic Bulletin No. 1.2, Airborne Magnetometer and Scintillation Counter Survey Over Parts of Trengganu and Pahang (Area No. 2), by W. B. Agocs. Part of the Colombo Plan report. Published by Ministry of Natural Resources, Federation of Malaya, Geological Survey, Ipoh. Price $5.

BOOKS presented on this page may be obtained directly from the publisher mentioned in each case. E&MJ does not sell books.

State Reports

Publication No. 5910, Bibliography and Index of Texas Geology, 1933-1950, by Roselle M. Girard. Published by the Bureau of Economic Geology, University of Texas, University Station, Box 8022, Austin 12, Texas. 238pp. Price $1.50.

Bulletin No. 1, Bibliography of the Geology and Natural Resources of North Dakota, 1814-1944 (with supplements one and two), by Chrissie E. Budge. Published by North Dakota Research Foundation and reprinted by North Dakota Geological Survey, Grand Forks. 61pp.

Bulletin No. 177, Geology and Mineral Resources of Santa Ysabel Quadrangle, San Diego County, California, by Richard Merriam. Published by State of California Dept. of Natural Resources, Division of Mines, Ferry Bldg., San Francisco 11, Calif. Maps, illustrations and 39pp. Price $1.50.

Bulletin No. 56, Geology of the Canelaria Mining District, Mineral County, Nevada, by Ben M. Page. Published by Nevada Bureau of Mines, University of Nevada, Reno. Maps, illustrations and 64pp. Price $2.

Bulletin No. 95, Flow Properties of Bulk Solids, by A. W. Jenike, P. J. Elsey and R. H. Woolley. Published by University of Utah, Salt Lake City. 51pp. Price $1.50.

Bulletin No. 96, Flow of Bulk Solids Progress Report, by A. W. Jenike, P. J. Elsey and R. H. Woolley. Published by University of Utah, Salt Lake City. 31pp. Price $1.

Proceedings of the Symposium on Hydraulic Fill, edited by W. A. Vine. Published by Montana School of Mines, Butte. Illustrated in 155pp. Price $3.50.

Mine Safety Orders, State of California. Published by Division of Industrial Safety and sold by Printing Division, Documents Section, Sacramento 14, California. Price 50c, plus tax.

Available Publications of the California Division of Mines. Available from Division of Mines, Ferry Bldg., San Francisco 11, Calif. 27pp.

Circular 2007, Regulations Governing the Filing of Mining Claims on Powersite Reserves. Tells what the claimant must do in detail. Copies may be obtained from Bureau of Land Management, P.O. Box 1018, Denver 1, Colo.

A Study of an Industry's Decline Due to Our International Economic Policies—the Domestic Brass Mill Industry. Published by the Copper & Brass Research Association, 420 Lexington Ave., New York 17, N. Y.

Refractories Bibliography—1947 to 1956, compiled by the joint committee of the American Iron and Steel Institute and the Refractories Institute. Published by University of Oklahoma Press, Norman, Okla. Indexed in 1822pp. Price $7.50.

Lubrication, Science and Technology, Vol. 1, No. 2, edited by John Boyd. Transactions of the American Society of Lubrication Engineers. Published by Pergamon Press, Inc., 122 East 55th St., New York 22, N.Y. Illustrated in 346pp. Price $10.

Filler Metals For Joining, by Orville T. Barnett. Reference book which summarizes industrial "how to." It covers all the ferrous and nonferrous joining situations. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Illustrated in 227pp. Price $7.

Geological Survey Report No. 12. Geology of the Newman Sound Map Area, Northeastern Newfoundland, by S. E. Jenness. Published by Department of Mines and Resources, Mines Branch, St. John's, Newfoundland. Maps and 53pp.

Geological Survey of Canada Memoir 289. Silurian Stratigraphy and Paleontology of the Niagara Escarpment in Ontario, by Thomas E. Bolton. Published by Department of Mines and Technical Surveys, Ottawa, Ontario. Maps, plates and 141pp. Price $2.

Annual Report of the Geological Survey of Tanganyika, 1957. Published by the Geological Survey Department, Dar es Salaam, Tanganyika. Map and 16pp. Price 2/50.

Short Paper No. 24. Geology and Gold Deposits of the Ruvu River Area, by B. N. Temperley. Published by Geological Survey Department, Dar es Salaam, Tanganyika. Maps on 37 pp. Price 10/.

U.S. Geological Survey

• Professional Papers and Bulletins from U.S. Geological Survey, as listed below, may be obtained from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Remittance should be made by money order.

Bulletin 1073, Quaternary Geology of the Smoke Creek-Medicine Lake-Grenora Area, Montana and North Dakota, by I. J. Witkind. 80pp. Price $1.75.

Bulletin 1084-B, Rapid Analysis of Chromite and Chrome Ore, by J. I. Dinnin. 37pp. Price 20c.

Professional Paper 299, Geology of the Arkansas Bauxite Region, by Mackenzie Gordon, Jr., Joshua I. Tracey, Jr. and Miller W. Ellis. 268pp. with part of illustrations in separate folder. Price unlisted.

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THIS MONTH IN MINING *(Continued)*

South African Official Attacks Gold Views

YET ANOTHER SIDE *of the international discussion of gold prices is presented in the following news article, by a leading member of the South African gold community. For other points in the discussion, see February 1959, p 113 (written by Dr. M. A. Kriz), the editorial on p 95 in the June 1959 issue, and last month's article on p 144, by Franz Pick.*

THE OFFICIAL American view on the price of gold was criticized by Peter H. Anderson, retiring president of the Transvaal and Orange Free State Chamber of Mines, at the annual meeting of the Chamber June 31.

In spite of the arguments put up by successive South African Ministers of Finance for a revaluation of gold—a view fully supported by the rest of the British Commonwealth—the attitude of the United States that the gold price must remain unchanged at $35 an oz has persisted, he said.

"As the United States can apply a veto in the International Monetory Fund's discussions, the problem of a revaluation of gold remains unsolved so long as what we believe to be the correct economic argument fails to convince the official American view."

But, he added, South African economists firmly believe that this view cannot be maintained indefinitely.

One well-used American argument against a revaluation of gold was the benefits of such a course to Russia.

But why possible benefits accruing to Russia should be a deterrent to the most satisfactory solution of the problem of liquidity in the free world it was difficult to understand. The economic health of the free "family of nations" should be the first consideration.

Furthermore, this fear of taking any line that could benefit the Soviet seemed to be based on an exaggerated conception of the magnitude of Red gold production.

Enquiries by the Chamber had failed to disclose any reliable information supporting the claim that Russian gold output was almost equal to that of the South African mines.

"Russia in recent years has not been slow to give considerable publicity to her achievements in other fields and I think it is reasonable to suggest that if, in fact, she had a spectacular gold production she would not maintain a coy silence about it."

Mr. Anderson pointed out that South African gold output last year reached the record figure of 17,154,005 oz fine —or more than 500,000 oz above that of the previous year.

Output for the first quarter of 1959 aggregated 4,539,888 oz, which was 451,456 oz higher than in the comparable period of 1958.

The figure for May—1,641,812 oz—

Peter H. Anderson

was over 200,000 oz in excess of that produced in the corresponding month last year and was, in fact, the highest figure ever attained in the industry in its 74 years of life.

"An examination of the known facts shows that the means by which Russia obtains foreign exchange are inconsistent with her having a gold production anywhere near that of South Africa. Personally, I believe that it is somewhat less than half of our production."

Uranium Potential Is Examined in Wisconsin

G. A. WEITMAN

WISCONSIN MAY YIELD ECONOMIC DEPOSITS OF URANIUM since pre-Cambrian rocks of the northern section of the state are similar in age and nature to Canadian uranium deposits across the Great Lakes. Glacial drift in this area is generally of great depth, with few exceptions, hence rock outcrops are scarce and most of the knowledge of subsurface formations must be obtained through test pits or drilling operations.

Several geological surveys were made during the past fifty years in an effort to locate iron or copper deposits. However, there is no record of any radiometric survey which may have been made in this area. While selected samples of ore grade uranium have been found, a deposit of such grade has not been located in the state.

During the past decade there were several reports of discoveries in Michigan, Wisconsin and Minnesota, however, in only one known locality are efforts being made to explore possibilities. This development is located in the Keweenaw Bay area of northern Michigan, near the village of L'Anse in Baraga County. Formations in this region are identical with those in northern Wisconsin. The Pilot Exploration Co. made a ground electro-magnetometer survey of a small area during the past year and also drilled three diamond drill holes with some trenching operations.

A much weathered sample from this site was a ferruginous chert containing hematite, pyrite and magnetite. The radiometric reading was fifteen above background. A recent progress report of the development indicated a deposit of value had not been revealed, however, it recommended a continuation of the electro-magnetometer survey.

During the past two years the writer has made a radiometric survey of a large portion of northern Wisconsin. Most of this area was previously covered by a magnetic survey conducted by the Wisconsin Geological & Natural History Survey during 1913 and 1914. A report of this survey was published in Bulletin No. 44, MINERAL LAND CLASSIFICATION by Hotchkiss. Many of the rock formations located and described in the report also occur in the producing horizon of the Blind River uranium district of Canada. (P.R. 1953-2; preliminary report by Abraham.)

The quartz-pebble conglomerate, described by Abraham as the host rock of the Canadian deposits, occurs in several localities in northern Wisconsin. Most of the known outcrops of this formation were checked by the writer with a counter. Readings from two to six above background were obtained. Taconite deposits located by the earlier survey gave readings from two to eight above background when taken at the described locations over much drift.

A weathered sample taken from the taconite development of the Ashland Mining Co. in the town of Agenda in Ashland County, was sent to the U.S. Geological Survey for assay. The report showed magnetite, ilmenite and hematite with a low percentage of uranium. A test for thorium was negative.

A check was made on the magnetic sands which are present along the south shore of Lake Superior in Ashland County. Readings from three to seven were obtained. The higher readings were obtained over a high magnetic area located by the writer when making a mineral resource survey during World War II.

A high magnetic area in Price County, located by the earlier survey, was also investigated. This formation consists of hornblende schist containing magnetite. Random boulders from this formation were found giving a radiometric reading of twelve above background. An outcrop of this formation was located by the earlier survey in this vicinity, but the writer was unable to locate the outcrop.

IN GEOLOGY OF WISCONSIN, Vol. 4, several outcrops of hornblende-schist

(Continued on p 135)

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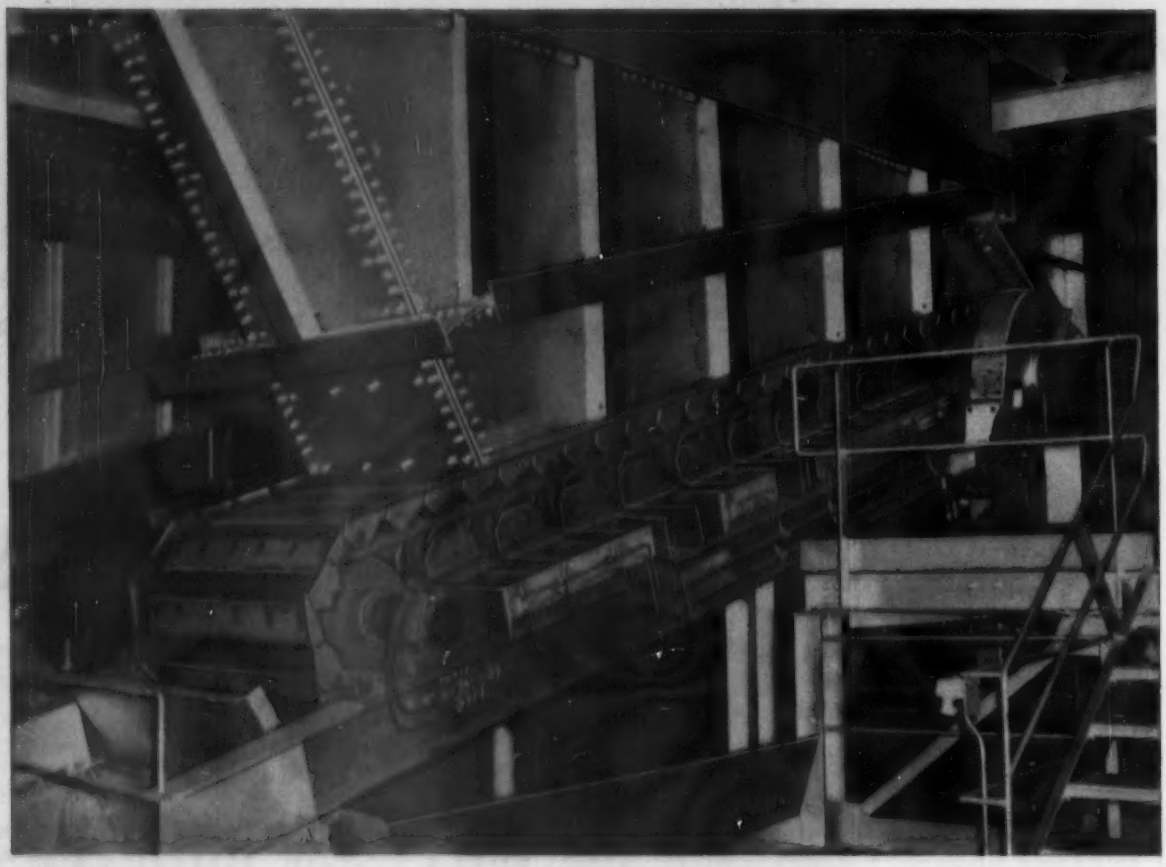

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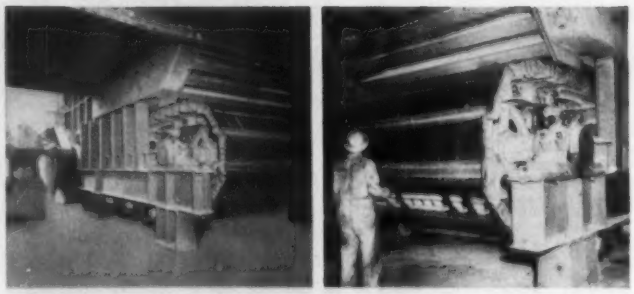

AMSCO Manganese Steel Pan Feeders handling copper ore at a Southwestern mine.

WRITE FOR BULLETIN 255

S-A

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Wisconsin Uranium *(Cont.)*

were located north of the area in which the boulders were found. An area underlain with pyritic chert was located in the south part of Rusk County near the contact of Huronian sediments and Cambrian sandstone. The location gave readings from three to five above background. Other locations were checked in Clark County which gave readings from three to five over background.

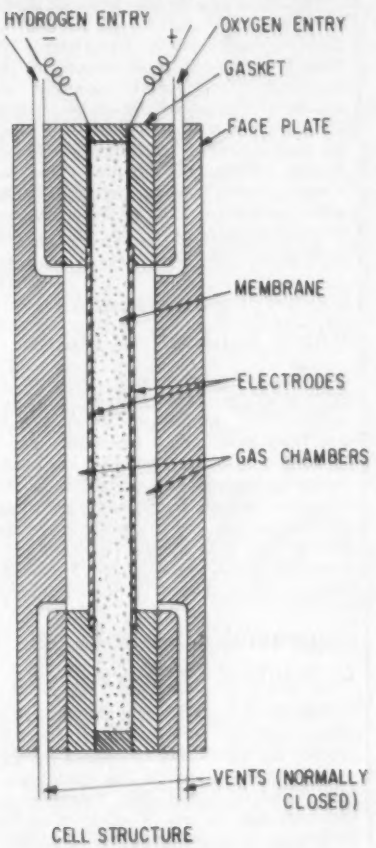
It was generally determined that all high magnetic areas gave relatively high radiometric readings when taken at surface locations over thick glacial drift.

Bear Creek Mining Co, has been active in the various counties in northern Wisconsin for prospecting rights on county-owned lands. Diamond drilling operations are in progress in several locations.

Results obtained by the present survey seem sufficient to warrant a more conclusive investigation through drilling operations. The later method will definitely determine whether uranium of economic value exists in Wisconsin.

Oxyhydrogen Fuel Cell Pilot Is Developed by G.E.

A FUEL CELL producing low-voltage direct current (E&MJ, May 1958, p 89) by reaction of hydrogen and oxygen gas has been developed by General Electric scientists Dr. Leonard W. Niedrach and Dr. W. Thomas Grubb. Current densities of up to 30 milliamps per sq cm have been produced.



CELL STRUCTURE

According to Dr. Guy Suits, G.E. vice president, the cell consists of a round disk about ½ in. thick and three in. dia. Its hollow interior is divided into to chambers by a special plastic membrane with an electrode in contact with each of its sides. Hydrogen is fed into one chamber, and oxygen into the other (air can be used). At one electrode, the hydrogen molecules break up into electrons and protons. Electrons travel through an external circuit to the other electrode, creating an electric current. Protons move through the membrane to the other electrode, where they combine with oxygen and the electrons from the external circuit to form water.

The new device operates efficiently at room temperature and atmospheric pressure. Thermal efficiencies over 60% have been obtained. The cell is still in the laboratory stage.

Navy and Air Force Drop HEF Production Programs

THE ROLE of boranes and other high energy fuels in the Federal defense program suffered a setback last month when the Navy and Air Force cancelled the opening of two big triethyl decarborane plants, one at Muskogee, Okla. and the other at Model City, N.Y.

Economy cuts were given as the reason for the moves, and some development program spokesman were quick to note that the cutback was against the recommendations of technical advisors of the program.

A side issue to the cutback was the interpretation by some observers that the HEF withdrawal might also mean an eventual move away from the B-70 "chemical bomber" program. The latter would mean one more blow to the already-weakened Government interest in titanium for jet planes.

Union Carbide Plans Paratungstate Output

PLANS for expanding the tungsten refinery at Bishop, Calif., have been announced by Lyman A. Bliss, president, Union Carbide Nuclear Co. The company will add two new processing steps to the flowsheet which will permit Bishop to turn out high-purity tungsten raw material—ammonium paratungstate—right at the mine site.

The process, said to be unique and still under wraps until patents are cleared, but believed to be solvent extraction, will be the first direct method for preparing pure tungstate from scheelite ore sources. Final product at Bishop will contain less than 0.003% each of molybdenum and silicon. The new plant addition will yield both ammonium paratungstate and scheelite concentrate and is scheduled to go on stream by year-end. First pilot plant was at Union Carbide's Sterling Forest research center, near Tuxedo, N. Y. The second is now operating at Bishop.

A thick mud overcoat on your tractor engine could cost you more than mink! Mud acts like insulation, impairs cooling of exposed surfaces—and you may be heading for an expensive overhaul. In any case, overheating steals power, spoils lube oil and cooks the life out of engines.

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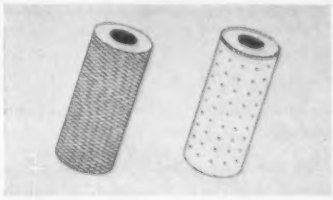

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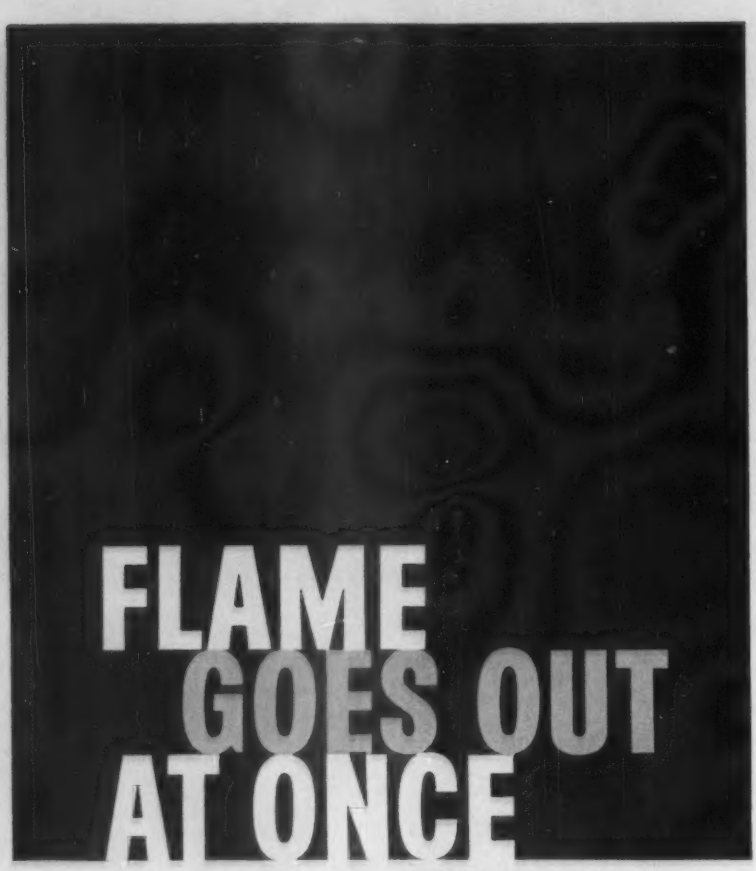

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Stauffer Chemical and Victor Schedule Merger

STOCKHOLDERS OF STAUFFER Chemical Co. and Victor Chemical Works, at meetings this fall, will be asked to ratify a merger of the two firms. When the expected approval occurs, it will create a 56-plant complex, principally in the phosphate field.

Victor operates phosphate mines in Montana and Tennessee and has operations in Florida. Stauffer, in addition to its interest in the electric beam melting plant of Stauffer-Temescal at Richmond, Calif. holds phosphate lands in Idaho, Utah and Wyoming, operates superphosphate plants in Tacoma, Wash. and Los Angeles and Richmond, Calif., and through San Francisco Chemical Co., controls phosphate lands south of Leefe, Wyo.

Successful Fusion Is Hinted In Navy Reactor

FUSION MAY HAVE BEEN achieved in a small research reactor at the Naval Research Laboratory in recent experiments according to the NEW YORK TIMES. No claim of fusion has been made, but Dr. Alan C. Kolb admits that temperatures as high as 15-million degrees have been reached and that as many as 100-million free neutrons (the usual indication that fusion has taken place) have been observed on a single run.

The Navy reactor is a small device one foot long and 1½-in. in dia., of the magnetic bottle principle. The powerful magnetic field induced in the experiments successfully contained the plasma of excited deuterium ions within the glass tube-reactor. The Navy is holding back claims of successful fusion until further evidence is obtained that the many neutrons released are really fusion neutrons and not stray or false neutrons as have been observed in other fusion reactors by other scientists.

Utah Construction Adds "And Mining" to Name

A SPECIAL STOCKHOLDERS' MEETING in Salt Lake City has authorized Utah Construction Co. to increase its capitalization from 2-million to 10-million shares of stock.

Shareholders also voted to change the corporate name to Utah Construction and Mining Co. and to eliminate present stockholders' pre-emptive rights to purchase additional stock issued. The company is headquartered in San Francisco.

Improved Zinc Recovery Is Studied at Noranda

LABORATORY WORK to date shows that a process, similar to the Sherritt Gordon process for nickel and developed by the same Professor Frank A. Forward, yields better zinc recoveries than conventional processes now in use. Recoveries up to 99% have been obtained. Based on this

fact, and the added advantages that iron in the ore does not interfere and that complex lead-zinc ores may be treated successfully, Noranda Mines Ltd. has signed an agreement to use the method after it has conducted a successful pilot plant program.

FABRICATING AGREEMENT—Hubert Fruehauf, president of Dow Metal Products Co. of Dow Chemical Co., and Fred M. Zeder II, president of Hydrometals have signed agreements for their firms for Dow to fabricate Hydrometals' new nonferrous sheet. The new alloy is a regulated blend of titanium, copper and zinc which "approaches mild steel" in structural strength, stability and scope.

IN THE U.S.

ALASKA

Fifteen miners are working placers on or near Porcupine Creek northwest of Haines. Four or five separate operations are being conducted, it was reported by the State Department of Natural Resources, Division of Mines. Porcupine Creek was a producer in the early days, and was the scene of much activity and extensive construction of placer mining facilities.

A contract has been let for the test drilling of the beach at Skagway for foundations for a proposed smelter.

Activity is increasing in the Chandalar. Frank Birch, mining contractor from Spokane, is drifting on the Mikado Lode for the Little Squaw Mining Co. and will extend operations to the Little Squaw Lode at a later date. Ed Toussaint has his new mill complete and ready to receive ore from the Summit claim, where he has two miners working. Hugh Matheson is placer mining on St. Mary's Creek, near its confluence with Big Creek.

Alaska Steel Mills, Inc. of Fairbanks, recently formed, is producing reinforcing

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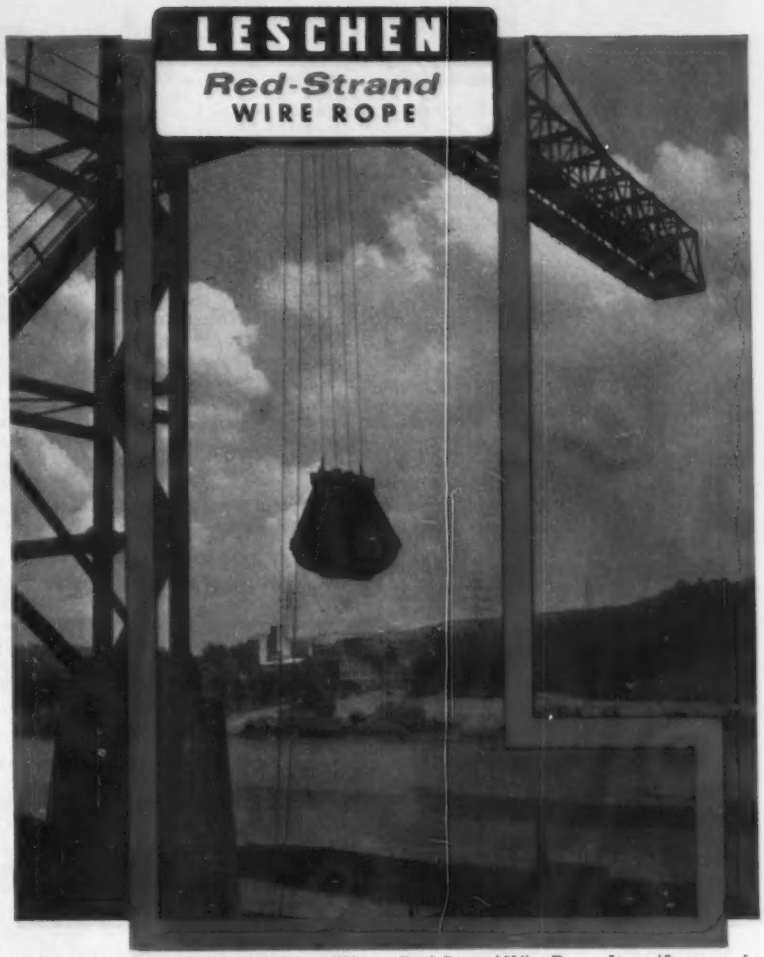

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CONSTRUCTION PROGRESS on International Nickel Co.'s $115-million fully integrated nickel mine, mill and smelter is speeding toward the 1960 production deadline. The 261-ft mine headframe and concentrator building (above) dominate the Manitoba landscape, along with the 500-ft smelter stack. Two hoists will be installed in the headframe. The shaft is now at 2100 ft, and other buildings completed.

Alaska *(Continued)*

steel from scrap iron in Seattle. The company expects to move the operation to Fairbanks when power becomes available there, probably next spring. It is understood that the hydro-electric plant being built at the end of Davidson Ditch will furnish the power.

The Alaska State Legislature is to open inaccessible areas of mineral promise whether any operators are active in the areas or not. The intent is not to benefit any one operator. Engineering on such roads is to be done by the State Public Works Department. The Division of Mines and Minerals must determine priorities among proposed roads and make recommendations before work goes ahead.

ARIZONA

Western Arizona's $1-million a year manganese mining industry came to a virtual standstill as Mohave Mining Milling Co., the state's largest producer, announced that it had stopped all mining and milling activity, effective Aug. 5. Only a sharply curtailed sintering operation will continue.

For the past three years, Mohave has produced manganese under the Federal carlot program and had a peak payroll of more than 100 employees. Government stockpiling was halted Aug. 5, when its original quota of 28-million long ton units was reached.

In addition to a large part of the Mohave force being laid off, Wells Cargo Inc., a trucking firm which held local manganese ore hauling contracts, said 20 drivers were dropped due to the shutdown.

Inspiration Consolidated Copper Co. announced its net income for the six months ended June 30, 1959 as $3,204,941 or $2.71 per share. For the same period in 1958, net income was $560,723 or $0.47 per share. Average delivered copper price for the company was 30.752c per lb for the first half of 1959. In the corresponding period for 1958 copper was sold at 25.185c per lb by Inspiration. For the year 1959 to June 30 deliveries of copper totaled $15,788,901. Costs, including operating expenses, development, maintenance, repairs and taxes other than Federal income tax totalled $10,458,938. Equipment and plant depreciation was $537,363. Estimated Federal income tax for the period was $1,274,600.

Indians on the San Carlos reservation in central Arizona have given Hunting Geophysical Services, Inc. of New York exclusive rights to survey for minerals on their lands. The contract is good for 14 months and covers 1.6-million acres. Following the survey, Hunting has the right to lease up to half of the reservation lands for mining purposes.

Phelps Dodge Corp. has filed protest with the Arizona tax commission over the $121.5-million tentative tax valuation placed on its property. Walter C. Lawson, vice president, protested that this is an increase of $8,826,294 on the five Phelps Dodge properties in the state.

Also filing a protest was San Manuel Copper Corp., which asked that a $3-million increase in valuations this year be stricken. W. P. Goss, San Manuel president, said the firm should have had a $6-million decrease, instead. The corporation's 1959 evaluation was $32,436,-235. Last year's figure was $29,565,462.

American Smelting & Refining protested a $12.5-million assessment on its Silver Bell copper operations in Pima County. A. C. Hall, assistant manager, said that for the past two years Silver Bell has paid 57% of its net profits in taxes.

CALIFORNIA

Uranium salts, mixed with other molten salts, may make a better fuel for high temperature nuclear reactors than uranium metal rods now in use, according to Dr. Haakon Flood of Norway. Dr. Flood explained that uranium metal rods have two major disadvantages. They lose shape when exposed to radiation and they do not work continuously, since the rods must be removed periodically to clean them of fission-caused impurities. Reactors using molten salts do not change shape and may be continuously purified by a recycling process.

Dr. Flood is visiting professor of engineering at the University of California and serving as advisor to U. S. atomic installations on chemical problems of fueling reactors with uranium salts.

Kaiser Aluminum & Chemical Corp. net earnings for the quarter ended June 30, 1959 were $9,016,000 D. A. Rhoades, president, announced in Oakland. Earnings for the same period a year ago were $5,414,000. Net sales for the second quarter were $124,060,000, compared with $98,543,000 for the same 1958 quarter. Quarterly earnings amounted to 52c per common share after preferred dividends, based on 15,006,711 shares outstanding, compared with 29c for the 1958 quarter, based on 14,702,034 shares. Primary reduction facilities had an annual capacity of 609,500 tons aluminum with 546,500 tons, or 90% of capacity in operation.

Record first-half sales and earnings were announced for Permanente Cement Co., Div. of Kaiser Aluminum by president Wallace A. Marsh in Oakland. Sales of $37,446,000 for the past six months ended June 30 were up approximately 34% from the $27,937,000 for the corresponding period of 1958, Marsh said. Net earnings for the recent first half totaled $5,312,000, equivalent to 93c a share, up 47% over the $3,624,000 or 63c a share earned in the first half of 1958.

In addition to the $13-million cement plant Permanente is building in Hawaii, Kaiser Gypsum, a subsidiary, has exercised its option to purchase a gypsum-rich deposit at Rosario, between Santa Fe and Albuquerque, N.M. Production for the 120,000 tpy gypsum products plant is scheduled to start in June 1960.

Bunker Hill Co. announced a loss for the second quarter of 1959 of $86,351, offsetting a first quarter profit of $54,484 and resulting in a loss for the first half of $31,867. In a report to shareholders, John D. Bradley, Bunker Hill president, explained that the major contributing factor in the downtrend in earnings was the one-half cent decrease in combined lead and zinc prices during the second quarter.

COLORADO

After a series of mill inspections the AEC has issued follow-up orders to operators of five uranium processing mills to assure that concentrations of radioactive material in mill areas and wastes discharged into streams are brought within permissible limits. The mills affected are the

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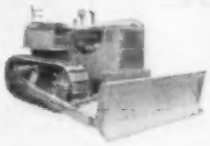

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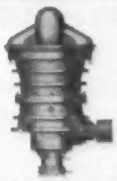

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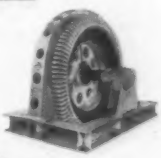

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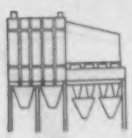

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Colorado *(Continued)*

Uravan, Colo. and Green River, Utah mills of Union Carbide Nuclear Co., the Durango, Colo. mill of Vanadium Corp. of America, the Maybell, Colo. mill of Trace Elements Corp. (a unit of Union Carbide Corp.) and the Salt Lake City, Utah mill of Vitro Uranium Co.

Corrective actions planned include improved control procedures for waste discharge into streams; further use of settling ponds to reduce toxic and radioactive materials in mill effluent; equipment additions and modifications to reduce mill dust including sprays, vacuum cleaners, air ducts and dust collectors. The mills will conduct improved survey programs to determine effectiveness of the new program.

In a related action, the Commission issued a letter order to Uranium Reduction Co. directing the company to submit by Aug. 15, 1959 a detailed plan for bringing operations at the company's Moab, Utah mill into compliance with regulations. Orders to other uranium mills will be issued, if warranted, as the inspections continue.

As part of its program to improve the safety aspects of mill operations, the AEC is financing an industrial waste survey of uranium milling operations on the entire Colorado Plateau. The survey is being made by the Public Health Service at the request of the Commission. Principal objective of the survey is full information concerning levels of mill effluents and guides for improved handling of mill wastes.

Work was started at the Joe Dandy mine at Cripple Creek, according to an announcement by Mrs. Josephine Frost, president. The mine has been closed since October 1955, when Mr. Frost died.

Air has been brought into the mine from the Cresson, below it. A power company is now putting in poles in preparation for bringing electricity to the mine. The mine has employed five men and they expect to begin operations on the first level. With the shaft and the surface plant in good order, the mine is in working condition.

Commercial shale-oil production is expected to begin between 1960-65, according to a new report prepared for the Colorado water conservation board by Cameron & Jones, Denver consulting engineers. Initial production (in western Colorado) would be 25,000-bbls per day, according to the report, but would reach 1.25-million bbls per day by 1975. Most of the shale-oil production will be along the Colorado River, between Rifle and De Beque, which will supply the necessary 50 to 100 gal of water per barrel of oil produced.

John B. Rigg of Denver has resumed drilling and drifting operations to evaluate copper and gold-bearing vein structures at Summitville. The DMEA program (copper-lead) is a 50% participation to test the continuation of previously mined ore shoots below the lowest old workings. Dr. Richard V. Gaines instituted the program three years ago and Wallace Rogers of Golden is contractor.

metal mining modernization

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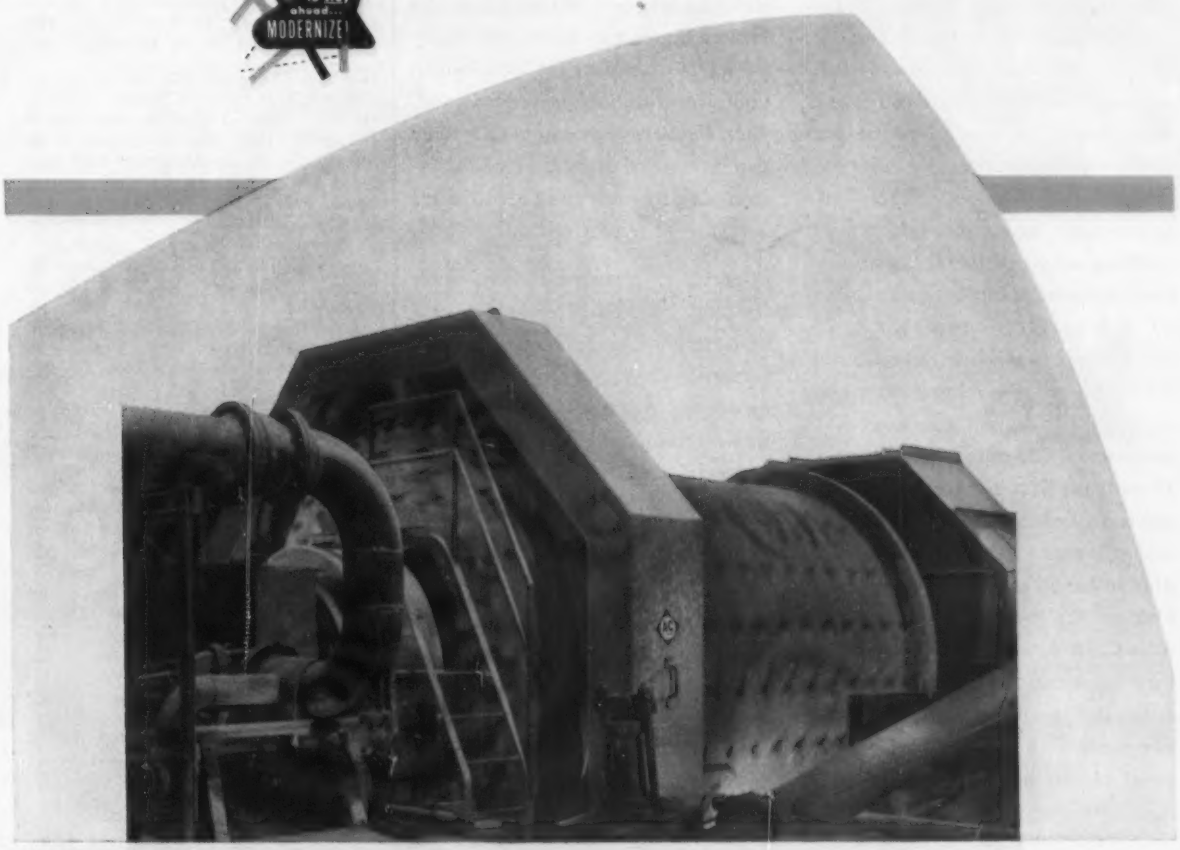

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Colorado *(Continued)*

The Colorado Supreme Court has ruled that counties have the right to retain mineral rights on lands sold for delinquent taxes. "The decision will immediately affect millions of dollars worth of royalty property in at least 16 Colorado mining and oil counties," according to J. Fred Schneider, attorney for the Colorado county commissioners association.

Idarado Mining Co. anticipates about 10 years of reserves of higher grade ore remaining in its San Juan property. During 1958, the firm milled a total of 382,100 tons of ore at its Pandora mill, averaging 0.08 oz gold and 2.08 oz silver per ton, 2.07% lead, 0.72% copper, and 4.48% zinc. In 1957, 457,850 tons had been milled. About 575,000 tons of low grade ore in an active area of the mine was re-classified and dropped from reserves because of lower metal prices.

A Ouray report says a new mill is being built by Camp Bird Ltd. at its Camp Bird mine. The old mill was wrecked and removed pending new construction. About 30 men are currently employed and the crew is being steadily expanded as development work continues. The famous mine was owned by Tom Walsh, who made a fortune on its gold-silver ore.

The Wah Chang ore mill, located on the road to Sugar Loaf, in Boulder County, has been sold to Earl G. Sweeney & Associates. They plan to operate it as a custom mill, handling any ores produced in the northern Colorado mining region. Wah Chang Corp. closed the mill in February and planned to dismantle it. Mr. Sweeney had been in charge of Wah Chang's buying and milling program for Colorado, Wyoming and New Mexico tungsten ores.

According to Mr. Sweeney, the mill will handle any type of ore that can be separated by flotation and gravity processes. "In a short time we will begin milling gold ore from the Dixie Mine at Idaho Springs. They're stockpiling ore now, waiting for us to begin operations."

Recent gold and silver strikes by the Little Jimmy Mining & Leasing Co. of Telluride are holding the attention of mining men in the San Juan country. New ore discoveries have been made in the mountains above Telluride at an elevation of some 11,000 ft. Myron C. Foster, president of the Little Jimmy Co. says that miners of the Little Jimmy are at present drifting in a 5-ft face of gold-silver ore assaying 2.76 oz gold, and 2.12 oz silver. He reports that they are presently blocking out ore and stockpiling it.

IDAHO

Salmon River Development, Inc. of Salmon, Idaho has completed and tested its mill for concentrating thorium and other ores. The company has also been doing extensive development work on its Sunnyside thorium claims. The work includes diamond drilling and tunneling to block out the ore. Ore bins and chutes

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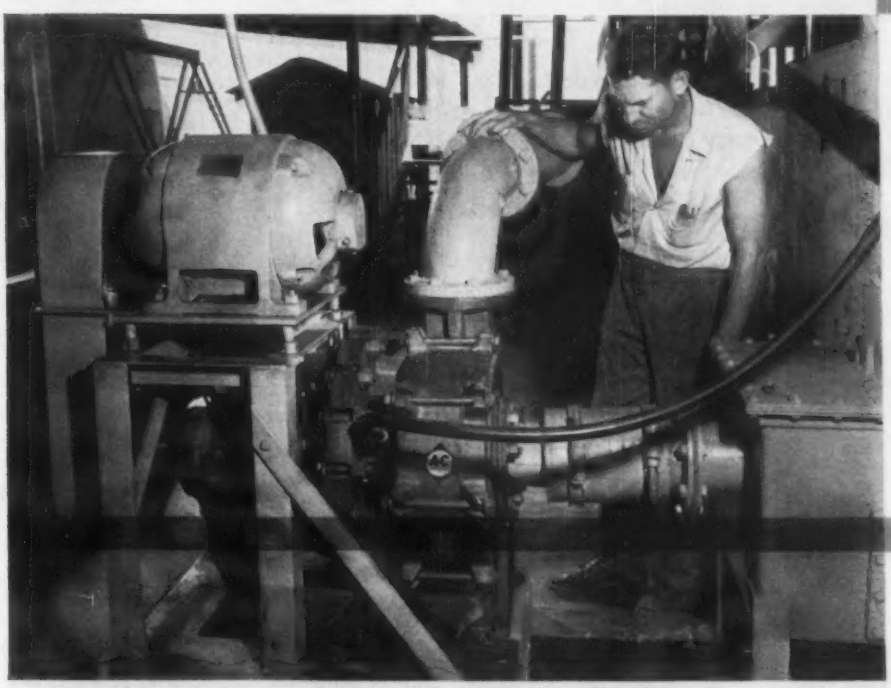

Titanium ore application makes good use of overhead motor mounting on A-C rubber-lined pumps.

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Idaho *(Continued)*

have been built and complete modern electrical equipment for handling ore at minimum cost has been installed, according to William Wilcox, president.

While developing and blocking out its ore the company will do custom milling for other property owners. Salmon River has contracted with Volpex, Inc. of N.J. to mill ore from Volpex's Agency Creek property. Volpex made its first delivery to the mill July 13. Mr. Wilcox plans to operate the mill on a full time schedule.

Net operating profit of Day Mines, Inc., for the second quarter of 1959 was $467,260, compared with $384,880 for the first quarter of 1959 and $347,005 in the second quarter of 1958, S. F. Heitfeld, secretary, has advised stock holders. Production during the second quarter, most of it from the company's Gold Dollar property in Ferry County, Wash., and the company's 25% share in the output of the Galena mine near Wallace was 27,066 tons during the second quarter, compared with 31,394 in the first quarter of this year and 26,537 in the same period of 1958.

The mining industry of Idaho has just completed raising $250,000 as its share of the total cost of a new $500,000 School of Mines building to be constructed on the campus of the University of Idaho at Moscow. The other $250,000 is provided in an appropriation by the 1959 session of the Idaho legislature.

The long-abandoned Mountain Chief lead-silver mine at the northern end of Priest Lake in Idaho is the scene of renewed activity by four Spokane mining men. It has been renamed the Plowboy, a four-mile road is being built to the property, a log cabin has been built there and a 1,000-ft tunnel is being cleaned out for future operations.

Abot Mining Co. of Wallace, which received an Office of Minerals Exploration grant for Government participation in an exploration project, has begun 1,000 ft of diamond drilling on the Pilot vein in the company's property at Mullan. The OME grant was for $21,775 and provides for 50% Government participation in a $43,550 drilling program. E. J. Longyear Co., Minneapolis, has been given the diamond drilling contract, Rollin Farmin, company president, said.

Crews working in the Red Elephant property west of Hailey, in south central Idaho, are reported by Mrs. Louise Lindsey, Jerome, one of the owners of the property, to have hit what appears to be a promising vein of silver-lead-zinc ore.

The O-level adit to the site of the No. 3 shaft at the Galena mine of the American Smelting & Refining Co. near Wallace has been completed and sinking of the mine's main shaft to a point 170 ft below the 4000 level has also been completed, J. C. Kieffer, manager of the company's northwestern mining department, reports. He also reports installation of a new ball mill at the Galena mill to replace a badly worn unit.

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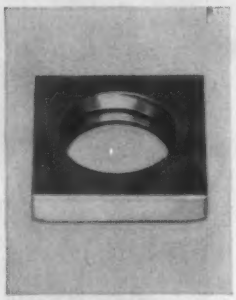
(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

Have you checked these three
REPUBLIC MINE ROOF

✓ PRECISION-TAPERED PLUG

Engineered for proper shell expansion. Note angle of taper in illustration—the precise degree required for strength, dependability, and quick efficient tightening. This improved Republic plug is versatile and adaptable, and is particularly effective in relatively soft formations.

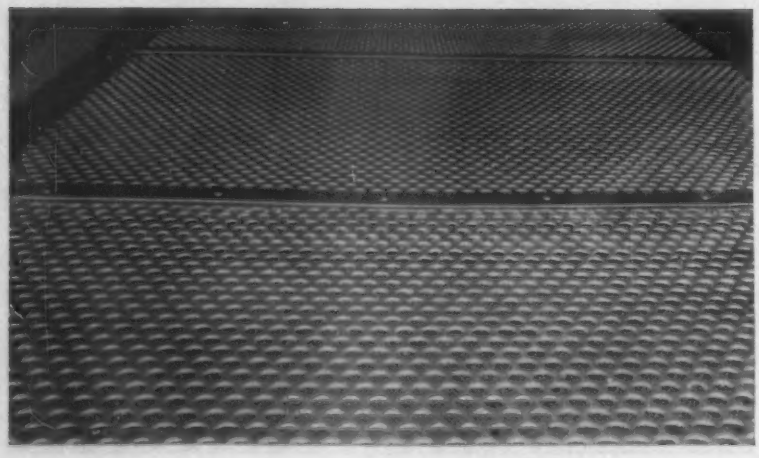
✓ HEAVY-DUTY SUPPORT NUT



Square nut provides over 40% better support than even the best previous method, yet maintains proper bolt tension by stripping at approximately 50 pounds torque with no damage to bolt threads. Here's another point: nut can be applied either side up to expedite assembly.

REPUBLIC ELECTRUNITE GROOVED-END TUBING offers cost-saving, time-saving advantages in many mining applications. It is quickly and easily joined with Victaulic Couplings. Portable field grooving equipment is available, too. Grooved-End Tubing is ideal for air, water, drainage lines, tunneling, and other heavy duty operations. As work moves ahead, lines can be taken up and relaid to conform with changing needs. Strong, rugged; engineered and produced to meet severe laying conditions. Send coupon.

SUPERIOR STRENGTH PLUS CORROSION-RESISTANCE are two of the many features of Republic High Strength Steel which make it ideal for a wide variety of mine industry applications. In mine car and hopper car use, for example, these factors contribute to greatly reduced maintenance. Republic High Strength Steel also provides good impact and abrasion-resistance. It will pay you to evaluate all of these advantages in terms of your equipment performance specifications. For more information, mail coupon.



SUPERIOR PERFORMANCE OF REPUBLIC ENDURO® STAINLESS STEEL used for this cleaning plant shaker screen has drastically reduced replacement expense. Reason is the excellent resistance of Republic Stainless to abrasion and corrosion. Other characteristics which pay service dividends in mine equipment applications include its good strength-to-weight ratio, easy cleanability, and high impact strength. In addition, Republic Stainless Steel is readily formed and welded, simplifying both manufacturing and maintenance operations. Mail coupon.

advancements in BOLTS?

✔ IMPROVED SELF-CENTERING HEAD

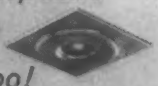
Compact, one-piece head eliminates need for second washer. Heavy flange, and thick, reinforced washer are guided cleanly and firmly into position in bolt plate. Entire unit forged, for ruggedness and strength. Standard 1⅛" head available with ¼" and ⅝" bolt sizes.

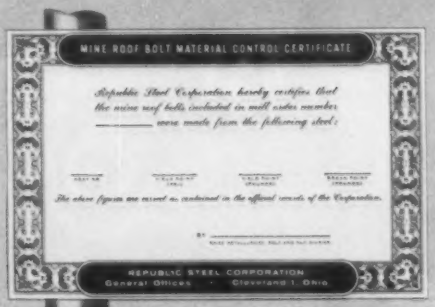
✔ CHECK THE COMPLETE UNIT

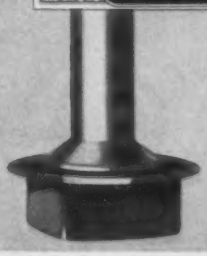
Can be shipped fully assembled as shown here

. . . to prevent loss of parts, prevent damage to bolt threads, save you assembly costs. Improved Republic RS-1 Expansion Shell, shown, provides extra strength, easy installation, in strata of any type.

Specify Republic Roof Bolt Plates, Too!




MINE ROOF BOLT MATERIAL CONTROL CERTIFICATE
Republic Steel Corporation hereby certifies that the mine roof bolts included in mill order number _____ were made from the following steel:
The above figures are extract as contained in the official records of the Corporation.
REPUBLIC STEEL CORPORATION
General Offices Cleveland 1, Ohio



MATERIAL CONTROL CERTIFICATE with every Republic Roof Bolt shipment gives specific physical properties of steel used. Data includes yield point in pounds per square inch, yield and break point in pounds, and steel heat number. Guesswork about performance is eliminated!

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
DEPT. EJ-8119
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send more information on:

☐ Mine Roof Bolts
☐ High Strength Steel
☐ Stainless Steel
☐ ELECTRUNITE Grooved-End Tubing

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

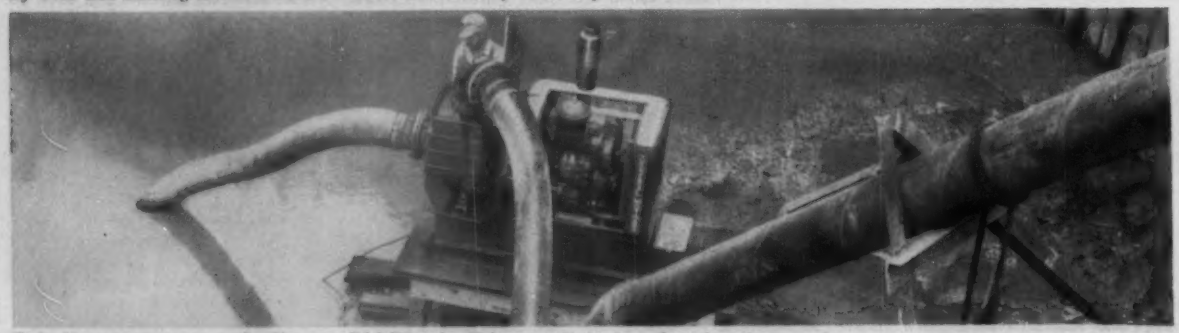
PROFIT NEWS FOR POWER USERS IN THE

all purpose power line

(20 TO 1650 H.P. IN ONLY 3 CYLINDER SIZES)

Now you can enjoy all the benefits of GM Diesel standardization in every type of equipment and still buy the best make of equipment on the market

GM Diesel engines are offered in more than 1800 applications of power equipment built by over 250 leading manufacturers—wider availability than any other Diesel



Only if a power user standardizes on GM Diesel will he get *all* the benefits of engine standardization—for *only* GM Diesel covers the entire power spectrum with only 3 cylinder sizes

Widest parts interchangeability pays off for fleet users in lower parts inventory requirements —for example, many parts for a 33 H.P. "Jimmy" Diesel fit a 1650 H.P. "Jimmy"

GM DIESEL

PARTS AND SERVICE WORLDWIDE

DETROIT DIESEL ENGINE DIVISION, GENERAL MOTORS, DETROIT 28, MICH.

In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario

MICHIGAN

The first skip load of iron ore to be hoisted from the M. A. Hanna Co.'s new Homer-Wauseca shaft at Mineral Hills was brought up July 6. The 2,700 ft deep, 20 ft dia. concrete shaft was begun in June 1957, and completed in December 1958. It is the only active circular shaft on the Menominee range. Its two 14-ton capacity skips can hoist 900 tph. The shaft is equipped with a Koepe hoist, built into the headframe, the only one on the Menominee range. Surface buildings, office and shops are being completed.

Inland Steel Co.'s two Menominee range mines, the Sherwood at Mineral Hills and the Bristol near Crystal Falls, had gone on a six day per week schedule about one week before the steel strike was called. The two mines employed some 210 men.

In the early morning of July 21 a fire was discovered at the 11 level of the Fogarty shaft of Pickards, Mather & Co's Buck mine at Caspian on the Menominee range. It was discovered by maintenance men. The mine is idled by the strike. The shaft has been sealed off at the 10, 11, 12 and 13 levels and at the collar. It is believed that the fire has been reduced to a small one, if any remains. It has not been possible to estimate the damage as it has not been considered safe to enter the area. The fire may have started from electrical wiring or equipment on the 11 level near the shaft.

A meeting of the northern Michigan mines safety exchange was held Aug. 6 at Bessemer, Gogebic range. Bert Marolla, safety inspector for Pickands, Mather & Co., was in charge of arrangements for the meeting. A tour was made of the surface buildings and equipment of the Peterson mine, operated by PM&Co. James R. Tregear, safety engineer for Republic Steel Corp., is president of the organization.

MINNESOTA

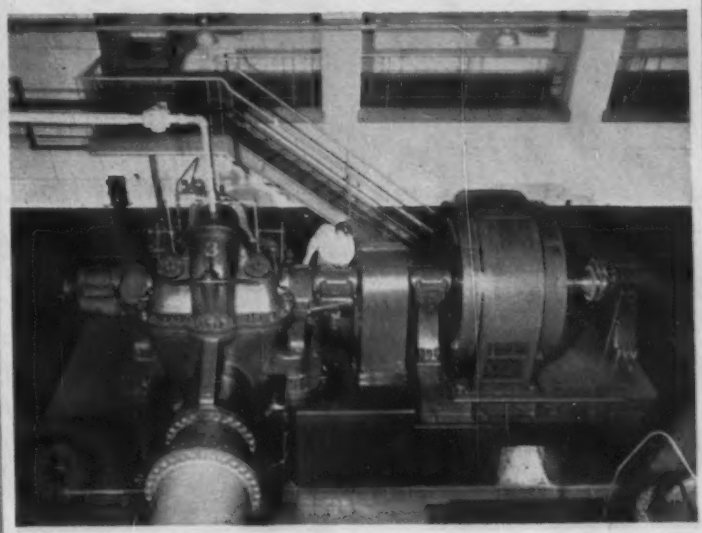
On July 17-19 the 75th anniversary of the first iron ore shipped from Minnesota was celebrated at Tower-Soudan. The Soudan mine, Vermilion range at Ely, made its first shipment on July 31, 1884, and has shipped every year since except 1904; a total of 15,307,598 tons up to 1959.

Iron ore shipments from the Great Lakes area for June were 12,987,302 tons as compared to 8,040,973 tons in June 1958. For the year to July 1, 28,732,533 tons had been shipped, more than double the 12,164,134 tons that had gone down the Lakes on July 1, 1958.

Gov. Freeman has signed the "semi-taconite" bill, which extends to certain low grade ores the tax advantages provided for taconite.

Inland Steel Co.'s new Armour No. 2 shaft, 662 ft deep, had begun hoisting

A case for F-M Split-Case Centrifugals!



Typical installation in Toledo averages 80.314% wire-to-water efficiency for year!

Exceptionally high and dependable efficiency with steady, low-cost operation year after year—that's the report from a host of municipalities and industries using Fairbanks-Morse pumps in their pumping stations.

Why? Ask stations like Collins Park High Service in Toledo, O., where five Fairbanks-Morse 36-in. Split-Case Centrifugal Pumps have been giving superb performance for 17 years. The No. 3 pump in the photo pumped 6,065,590,000 gallons in one year alone, handling 26.13 percent of the plant total, and consuming just 3.55 kilowatts hours per million foot gallons!

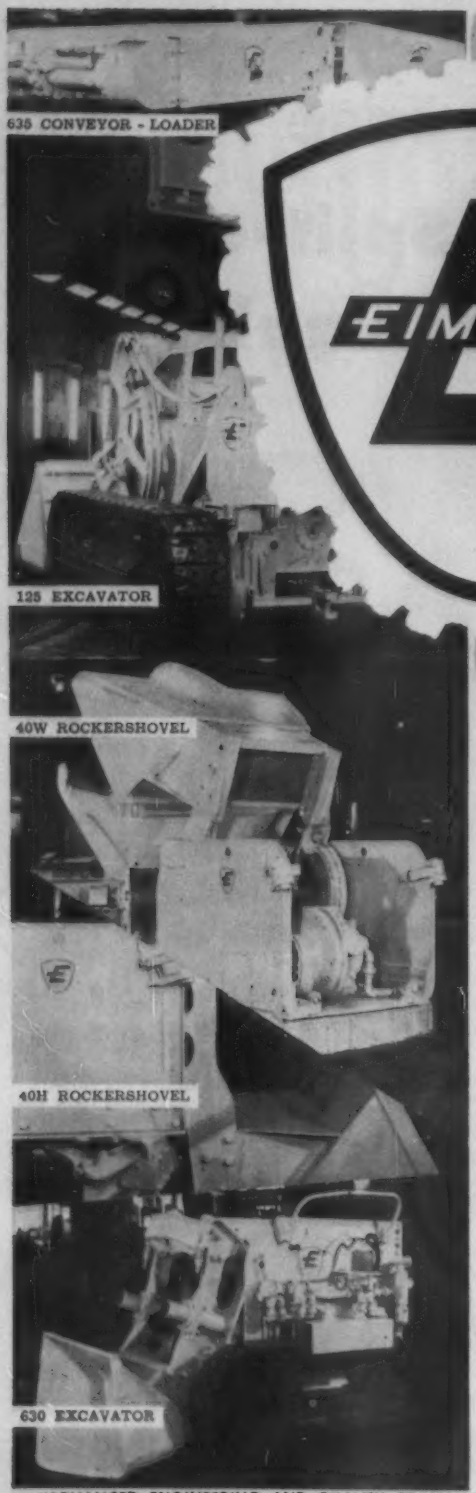
Your Fairbanks-Morse Field Engineer welcomes you to inspect many other reports like this from his files—reports revealing why no other manufacturer can match the experience of Fairbanks-Morse in providing pumps and drivers for both municipality and industry. Your F-M Field Engineer will be glad to work with your own engineers in selecting the best equipment for your specific requirements. Write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

See Sweet's Product Design Catalog File for complete F-M Pump Line.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • ELECTRIC MOTORS • DIESEL, DUAL FUEL AND GAS ENGINES
LOCOMOTIVES • COMPRESSORS • GENERATORS • MAGNETOS • HOME WATER SYSTEMS



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.....on any underground loading and mining machine is your assurance of increased productivity and lower production costs.

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So why settle for less than the best? It costs no more to specify and buy the standard of quality in underground loading machinery and equipment . . . Eimco Quality.

For details, specifications or qualified engineering assistance, please contact The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah, U.S.A.

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THE EIMCO CORPORATION

EIMCO

MINING EQUIPMENT DIVISION

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SALT LAKE CITY, UTAH — U.S.A.

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BRANCHES AND DEALERS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

a million shots without a miss!!!*

Upper Left: INSTANTANEOUS (Copper Leg Wires)
Upper Right: INSTANTANEOUS (Iron Leg Wires)

Over the years, Cyanamid Electric Blasting Caps have achieved this enviable record for never-miss shooting. Millions of mine . . . quarry . . . and construction shots have been fired accurately, dependably and economically by using Cyanamid — the *best* in electric blasting caps! Cyanamid makes a cap for every blasting need.

Instantaneous, regular or split-second delays . . . Cyanamid Electric Blasting Caps offer you these advantages: CHOICE OF DELAYS • TIMING ACCURACY • HIGH DETONATION STRENGTH • SUPERIOR INSULATION • COLOR-CODED FOR EASY IDENTIFICATION.

Make every shot count! Insist on Cyanamid Blasting Caps and Explosives!

**An actual, documented case history of a leading coal mining company.*

AMERICAN CYANAMID COMPANY
EXPLOSIVES AND MINING CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N. Y.

CYANAMID

9 years of field service prove safety and long life of

B.F.Goodrich

WHAT'S THE MOST IMPORTANT THING ABOUT A BRAKE?

You hear a lot of arguments about which kind of actuation is best! But unless the brake itself has the inherent capacity to absorb energy and stop without fade, actuation is a lever without a fulcrum.

B.F.Goodrich Hi-Torque Brakes, with exclusive full circle stopping power, have twice the capability of ordinary two-shoe brakes — stop twice as fast under actual operating conditions. More uniform lining pressure keeps brake drum heat to a minimum—reduces the chance of fade on those long, steep grades. And Hi-Torque Brakes perform equally well whether the actuation is air or direct hydraulic. Both systems are available only with B.F.Goodrich Hi-Torque Brakes.

Specify the one brake designed with reserve power to give you faster cycle times, greater safety. B.F.Goodrich Hi-Torque Brakes are available in sizes from 17¼″ x 4″ to 26″ x 7″. They need no lubrication, adjust themselves automatically. Contact your equipment supplier or B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept.EM-99, Troy, Ohio.

B.F.Goodrich ***Hi-Torque brakes***

9 years of field service prove safety and long life of Fatigue-resistant (USS) Tiger Brand Boom Support Assemblies

Nine years ago, American Steel & Wire Division introduced a *fatigue-resistant* Tiger Brand Wire Rope Boom Support Assembly. It was designed to combat the severe vibration on power shovels, draglines and cranes. Since then, it has been installed on thousands of machines with outstanding success.

Effectively dampens vibration. The spliced section gradually dampens vibration instead of concentrating it at one point. This results in greater safety and *much longer cable life.*

Visibility increases safety. With this construction, inspection is easy and the development of broken wires is readily detected. They are not hidden in a shank or socket basket. Thus, you can tell when to replace the assembly in time to prevent accidents.

Easy application. There's no need for extensive alteration of your present equipment. Tiger Brand Wire Rope Boom Support Assemblies are made with standard-size fittings. These are completely interchangeable on standard equipment. For further information, contact our nearest office or write American Steel & Wire, Dept. 9219, 614 Superior Ave., N. W., Cleveland 13, Ohio.

USS and Tiger Brand are registered trademarks

Greater safety—20% longer service life was obtained from these Tiger Brand Boom Support Assemblies used on a crane owned by the Hunkin & Conkey Construction Co. in Ohio.

Vibration is effectively dampened by these Tiger Brand Boom Pendants with spliced ends. The splice can be readily inspected for broken wires—an added safety factor.

American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

Four reasons why this NI-HARD cast drop ball is a smash hit!

This Ni-Hard* cast iron drop ball is dedicated to a long life "on the rocks." Its service record – and that of other GIW Ni-Hard drop balls produced by the Special Products Division of Georgia Iron Works, Augusta, Ga.– has proved to be *four* times longer than that of any other type ball. In fact, most GIW Ni-Hard balls have replaced forged steel balls. Here are four reasons why:

• **Design.** Notice the design of the ball. It has been quoted to be so well balanced that the operator is able to lift and drop the ball more times per shift. One operator stated that his overtime was eliminated when he started using Ni-Hard balls.

• **Abrasion resistance.** Ni-Hard is one of the hardest commercial products of the iron foundry, possessing outstanding abrasion resistance. This important property enables Ni-Hard balls to withstand the severest wear of the hardest rocks.

• **Strength and toughness.** In addition to abrasion resistance Ni-Hard drop balls are tough enough and strong enough to withstand impact in this most demanding operation. They resist breaking or chipping.

• **Economy.** Only a Ni-Hard *cast* drop ball could be economically produced to take advantage of the money-saving features mentioned above. And, of course, the long service life of Ni-Hard drop balls means greater operating economy.

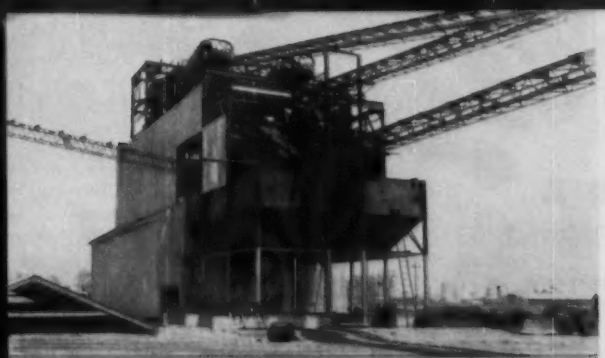
Put these Ni-Hard advantages to work for you. Next time you buy drop balls, get in touch with a Ni-Hard producer. There's one near you. If you don't have his name, write Inco for a list of authorized Ni-Hard producers.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

NI-HARD

NICKEL MAKES ALLOYS PERFORM BETTER LONGER



In Standard Materials Corporation's Maywood (Indianapolis) plant, two 10" x 30' McLanahan Log Washers.

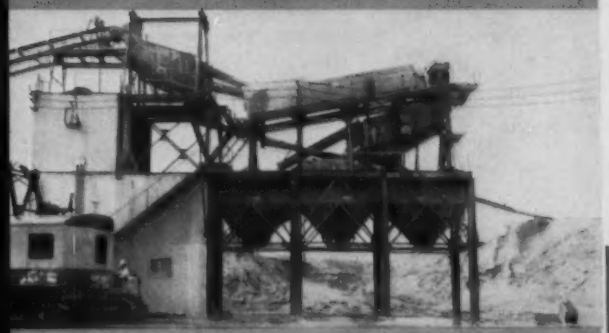
Selected by

STANDARD MATERIALS

not once but

10 times

This progressive Indiana and Kentucky operator selected eight McLanahan Mudmaster Log Washers for installation in seven gravel plants during a two year period.



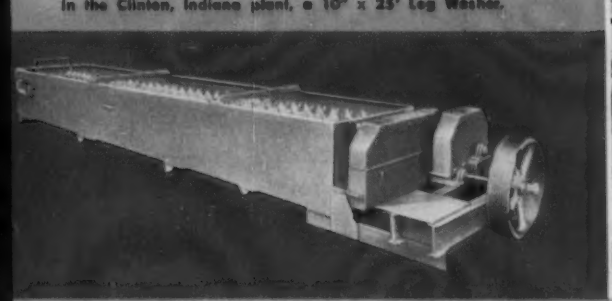
In the Plainfield, Indiana plant, a 10" x 25' Log Washer.

In the Clinton, Indiana plant, a 10" x 25' Log Washer.

McLANAHAN SINCE 1835

LOG WASHERS

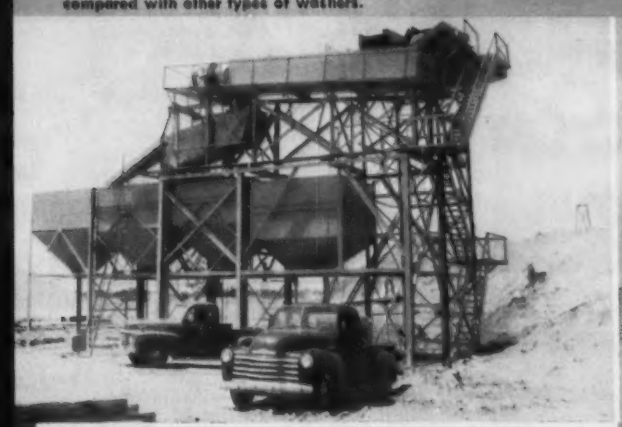
McLANAHAN AND STONE CORPORATION
HOLLIDAYSBURG, PENNSYLVANIA



Fundamentals with McLanahan Mudmasters—cleaner product, profitable tonnages, up to 40% lower power requirements, compared with other types of washers.

In the Milton, Kentucky plant, a 10"x30' McLanahan Log Washer.

In the Burlington, Kentucky plant, a 10"x25' McLanahan Log Washer.

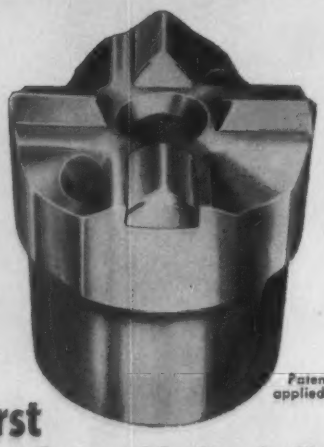


In Standard Materials' 86th Street (Indianapolis) plant, a 10" x 25' McLanahan Log Washer.

New under construction, at the Speedway (Indianapolis) plant—one 10"x30' and two 10"x25' Logs.

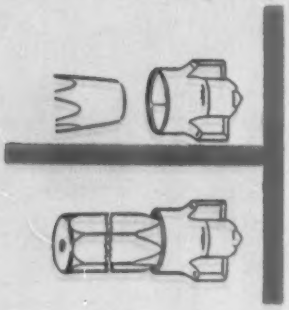
LIDDICOAT

the tungsten carbide bit that needs no resharpening



Fast drilling—long life—low first cost—low cost per foot of hole drilled

The exclusive, shallow, long-life inserts need no resharpening because they do not develop a reverse taper dullness . . . a condition that stops drilling in the conventional multi-use bit. The exclusive design of LIDDICOAT permits fast drilling far beyond the point where conventional multi-use carbide bits must be withdrawn from service for resharpening. Fast drilling continues during the entire bit usage without need of resharpening.



Taper socket — No threads — Fast, firm attachment

The type TS Tee Cee Liddicoat (no resharpening) bit has a completely new, short-taper socket connection. Within the socket of the bit is a brass shim. The socket, which is completely forged, is tapered to correspond to the taper placed on the drill rod. The connection assures an absolute attachment to the rod, and yet permits easy removal.

Forged for toughness from nickle alloy steel

Bodies for Liddicoat bits are produced by forging. By a patented manufacturing process, the alloy steel is subjected to tremendous pressure which extrudes it into the desired shape. This method preserves the important grain of the steel, flow lines being compressed rather than cut across as is usual in forgings of this type. The retention of the unbroken grain and the compression of the material gives Liddicoat bits an unusually strong structure.

WESTERN
Rock Bit
Manufacturing Company
552 West 7th South Salt Lake City 1, Utah

Minnesota *(Continued)*

ore on June 15 and shipped until halted by the strike on July 14. The Armour No. 1, which had produced 6,783,393 tons up to 1959, is mined out. Armour No. 2 had mined 6,626,065 tons up to that date and has about 3-million tons remaining. Both properties were opened in 1912.

Pickands, Mather & Co. was operating its Cuyuna range Rabbit Lake mine on the shore of the dewatered lake until interrupted by the steel strike. The mine was idle in 1958. About 1,420,000 tons have been shipped from the mine with 4,644,225 tons remaining.

Garden Lake Iron properties, Inc. has begun drilling on eight forties about three miles northeast of Winton, near Ely. A small amount of prospecting was done in 1889 when the firm was organized. It was reorganized in 1913, but has been inactive until this year. Arthur B. Puent of Two Harbors, is president of the company. It expects to spend about $25,000 in diamond drill work. Atkins-Walker Co., Duluth, is doing the exploration drilling.

Since work began at the Pierce mine of the M. A. Hanna Co. in 1957, over 5-million cubic yd of surface and rock have been moved. Total stripping will reach approximately 25-million cubic yd. During 1958-59 a 280-acre tailings basin has been constructed. More than 1.2-million cubic yd of material were used to build the dike around it, most of it borrowed from within the pond area. During this season (strike settlement permitting) stripping will continue and a screening unit in the pit, ore stacker, plant and loading pocket will be nearly completed. The plant will include crushing, screening, heavy media, cyclones and spirals.

Completion was not attained until this spring. The plant has an annual capacity of 550,000 tons of concentrates. By April 16 it was operating on a 20 shift-per-week schedule. Total employment is about 160 men, and the plant will operate all year. Of the 11 magnetic orebodies at Moose Mountain, only the 5,000 ft long No. 2 body is being mined at present. Its width varies from 100 to 600 ft, it is nearly vertical with frequent outcrops and the overburden is light. Rotary drills, with rounds of 45 to 50 holes to a blast, shovel loading and truck haulage are employed. Drill holes are loaded with a mixture of Hydromex and ammonium nitrate and a single blast produces 35,000 to 40,000 tons of crude ore, enough to serve the plant for about 10 days.

The mine works one or two shifts a day while the plant works three shifts. Currently two 6-yd shovels are loading into eight 22-ton trucks. A 2500-ft haul up a 7% grade delivers the crude ore to the primary crushers.

Crude is dumped onto a 78-in apron feeder which carries it to a 6-in. grizzly, the oversize going to a 66x84-in. jaw crusher.

The primary crusher reduces the crude

x 25' McLanahan Log Washer.

plant—one 10"x30' and two 10"x25' Logs.

B.F.Goodrich

It's a rugged, rock-strewn strip mine—the place where B.F.Goodrich tires pay off!

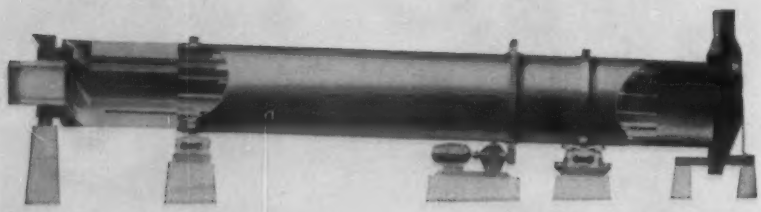
TON after ton of rock and overburden crash into that truck, to be hauled out of this Pennsylvania strip mine on a road littered with jagged rock. Trucks work 70 hours a week. Gross loads reach upwards of 44 tons. Sky-high tire costs? Not for this company. They use B.F.Goodrich Rock Service tires. The company reports Rock Service tires give as many as 3,000 hours of service on the original tread—can still be retreaded twice!

B.F.Goodrich builds the Rock Service with a special cut and snag-resisting tread compound. Double-chevron cleats grip the ground, defy dangerous skids. You get more retreadable tires with Rock Service tires, thanks to the B.F.Goodrich FLEX-RITE NYLON cord body. This B.F.Goodrich nylon withstands double the impact of ordinary cord materials, resists heat blowouts and flex breaks. No wonder strip mining is a place where Rock Service tires really pay off!

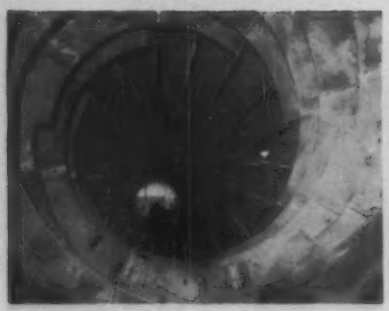
Visit your nearby B.F.Goodrich Smileage dealer today. He has tires for every kind of mining job—tires that will save you money. *The B.F.Goodrich Company, Akron 18, Ohio.*

Specify B.F.Goodrich Tubeless or tube-type tires when ordering new equipment

B.F.Goodrich *off-the-road tires*



from
Alumina ores
to
Zircon concentrates

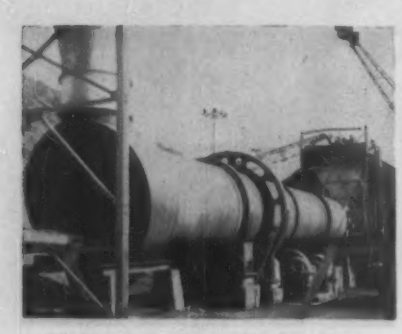


Interior of shell of "XH" Ruggles-Coles Dryer showing lifting flights and feed spirals.

. . . in the drying of ores and concentrates. That is the story of Ruggles-Coles "XH" Dryers.

Small or large, each dryer is designed for the specific requirements of the user with the knowledge and experience gained from hundreds of installations.

Complete specifications upon request. Ruggles-Coles Dryers are described in Bulletin AH-438-1.



10′ diameter, 80′ long "XH" Ruggles-Coles Dryer drying bauxite in Jamaica.

Four 80″ diameter, 60′ long "XH" Ruggles-Coles Dryers handling asbestos ore in Canada.

HARDINGE
COMPANY, INCORPORATED
YORK, PENNSYLVANIA • 240 ARCH ST. • Main Office and Works
New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco • Birmingham • Jacksonville Beach

Minnesota *(Continued)*

to minus 8 in. A 42-in. conveyor belt then carries the crude to a 15x16x13-ft (3,120 cubic ft) 100-ton storage bin located over the secondary crusher units. From the bin ore goes to a 54x84-in. vibrating feeder and then to a 6x12-ft x ⅝-in. screen. Minus ⅝-in. is carried to one of three 41-in dia. x 53-ft. high storage silos at the concentrator building. The plus ⅝-in. is diverted to a 7-ft. secondary cone crusher, then to tertiary screens and crushers before going to the 3,450-ton capacity storage silos.

Final beneficiation begins when the now minus ⅝-in. crude goes from the storage silos to a 24-in. belt.

It passes over a registering weight meter and an electronic sampler which gages the amount of magnetic iron in the crude. The crude averages about 35%Fe which is brought up to about 65% in the concentration plant.

The concentrator has three production lines. Water is added at the beginning of the concentrator cycle at about 10,000 gpm. As much water as possible is recovered for reuse. After passing over the weight meter, the crude is reduced to 10 mesh in a 9x12-ft rod mill and discharged onto three 4x6-ft screens. Next through a 36x48-in. cobber magnetic separator and then to a ball mill in closed circuit with two 36x72-in. rougher magnetic separators and a battery of 10-in. cyclones for separation of plus and minus 270 mesh. The ¼-in. screened oversize goes directly to the ball mill-separator-cyclone circuit. After reduction has been completed, the product is put through a 26-ft desliming hydroseparator before the final magnetic separation. Crude then passes through a three-way distributor, then to 36x72-in. finishing magnetic separators. After going through a 22-ft thickener, the concentrate is demagnetized, filtered and carried by belt to a loading pocket.

From there it can be loaded into trucks for stockpile or to railroad cars for shipment to Depot Harbour on Georgian Bay. The fine-ground product will be used in at least two ways, as a richer, sintered feed for the blast furnace, or as a "sweetener" for some of the lower grade ores mined by Hanna in Michigan and Minnesota.

MONTANA

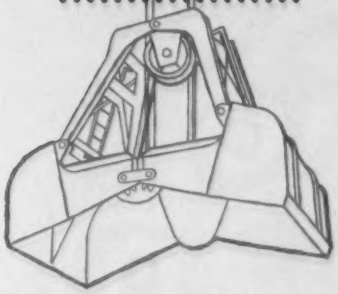
The zinc plant of the Anaconda reduction works was closed Aug. 10 it was announced by Edward I. Renouard, vice president in charge of Anaconda Co.'s western operations. He said the decision was made because of the diminishing tonnage of zinc concentrates now being processed.

The Anaconda zinc plant has six units but only two of them have been working and one would be shut down because lesser tonnages of zinc concentrates are now being received from the company's mines. To work only one unit of the Anaconda zinc plant would be far too costly under present market conditions,

INDUSTRIAL BROWNHOIST

OPEN TYPE COAL AND ORE GRAB BUCKETS CARRY BRIMMING PAYLOADS...

EVERY BITE!



Built to the same rigid standards of quality as are all INDUSTRIAL BROWNHOIST machines, these open-type coal and open-type ore buckets are designed for perfect weight distribution, to increase the payload.

Simplified construction makes upkeep simple. Annealed steel castings, alloy steel shapes and plates assure a lifetime of powerful service. I-B open-type coal grab buckets range from 84 to 480 cu. ft. capacities; ore buckets from 120 to 275 cu. ft. . . . and in custom designs where necessary for special requirements.

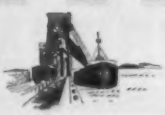
For further information on I-B job-engineered buckets —open type grab, link type, flush link type and clamshell—write for your copy of new catalog 574, just off the press. It gives you complete specifications on all I-B buckets and grapples, and contains many photographs of this money-making equipment at work.

BROWNHOIST

CLAMSHELL BUCKET

250 TON WRECKING CRANE

COAL-ORE BRIDGE



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LOCOMOTIVE CRANE

INDUSTRIAL BROWNHOIST CORPORATION, BAY CITY, MICHIGAN • DISTRICT OFFICES: New York, Philadelphia, Cleveland, Chicago, San Francisco, Montreal, Canada • AGENCIES: Detroit, Birmingham, Houston

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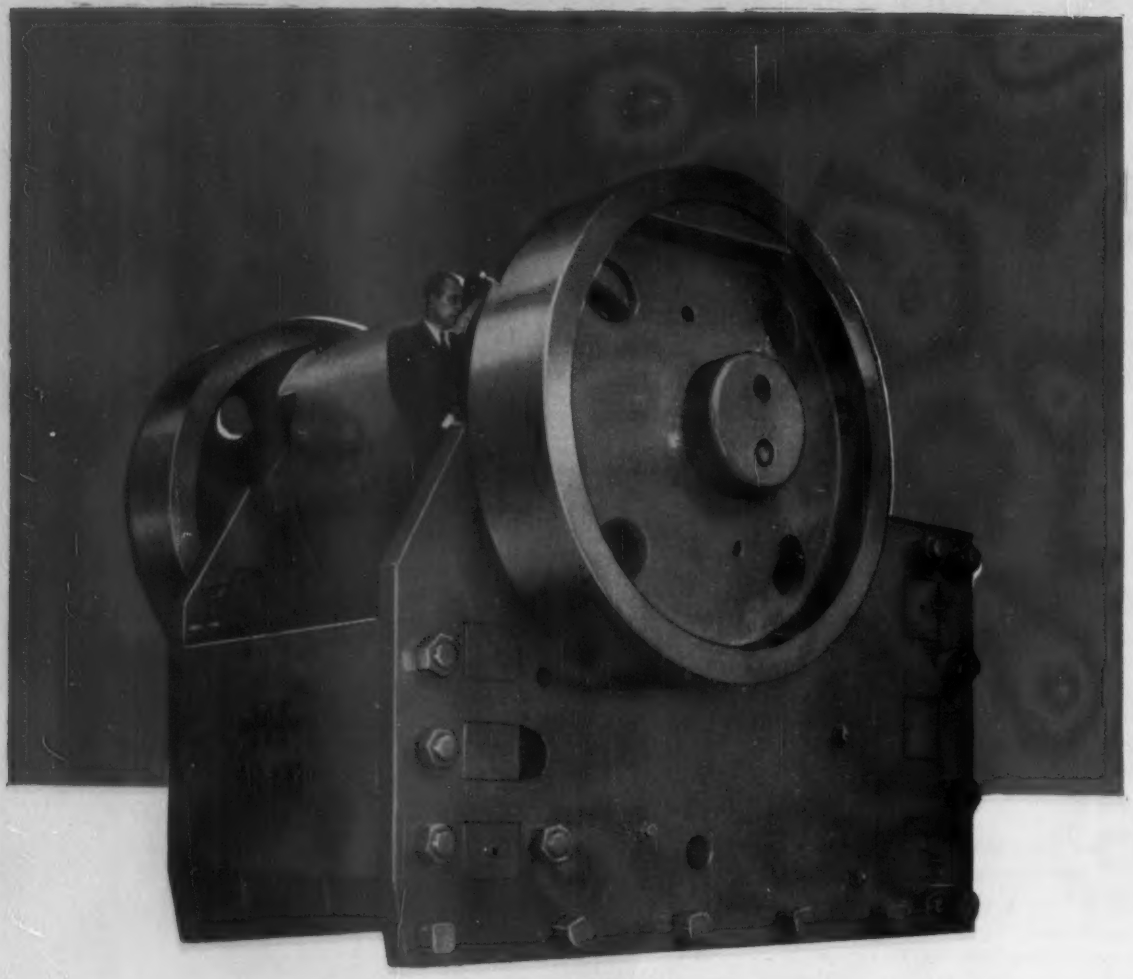

Boulder Crusher AR-180

Six of these huge crushers are being supplied for use underground in Swedish iron mines at Kiruna and Malmberget.

The AR-180 with its 71" x 55" feed opening is the largest single-toggle type Jaw Crusher in the world. It can accept blocks of iron ore up to 10 tons and reduce these to 16" thickness. It can be dismantled into component parts suitable for transportation and erection underground.

Built in three sizes

TYPE	FEED OPENING	SETTING	MIN. MINE SHAFT DIMENSIONS	NETT WEIGHT
AR–120	47" × 35"	12"	36" × 73"	81500 lbs
AR–150	59" × 47"	12"	57" × 89"	170000 lbs
AR–180	71" × 55"	16"	60" × 98"	256000 lbs

Single-toggle design — simple and strong.
Frame in sections, with interlocked bolted joints.
Side frames for the AR-180 and AR-150 are of heavy steel plate.
SKF spherical roller bearings — grease lubricated throughout — avoiding oil leakage. Low idling power consumption.

MH MORGARDSHAMMAR

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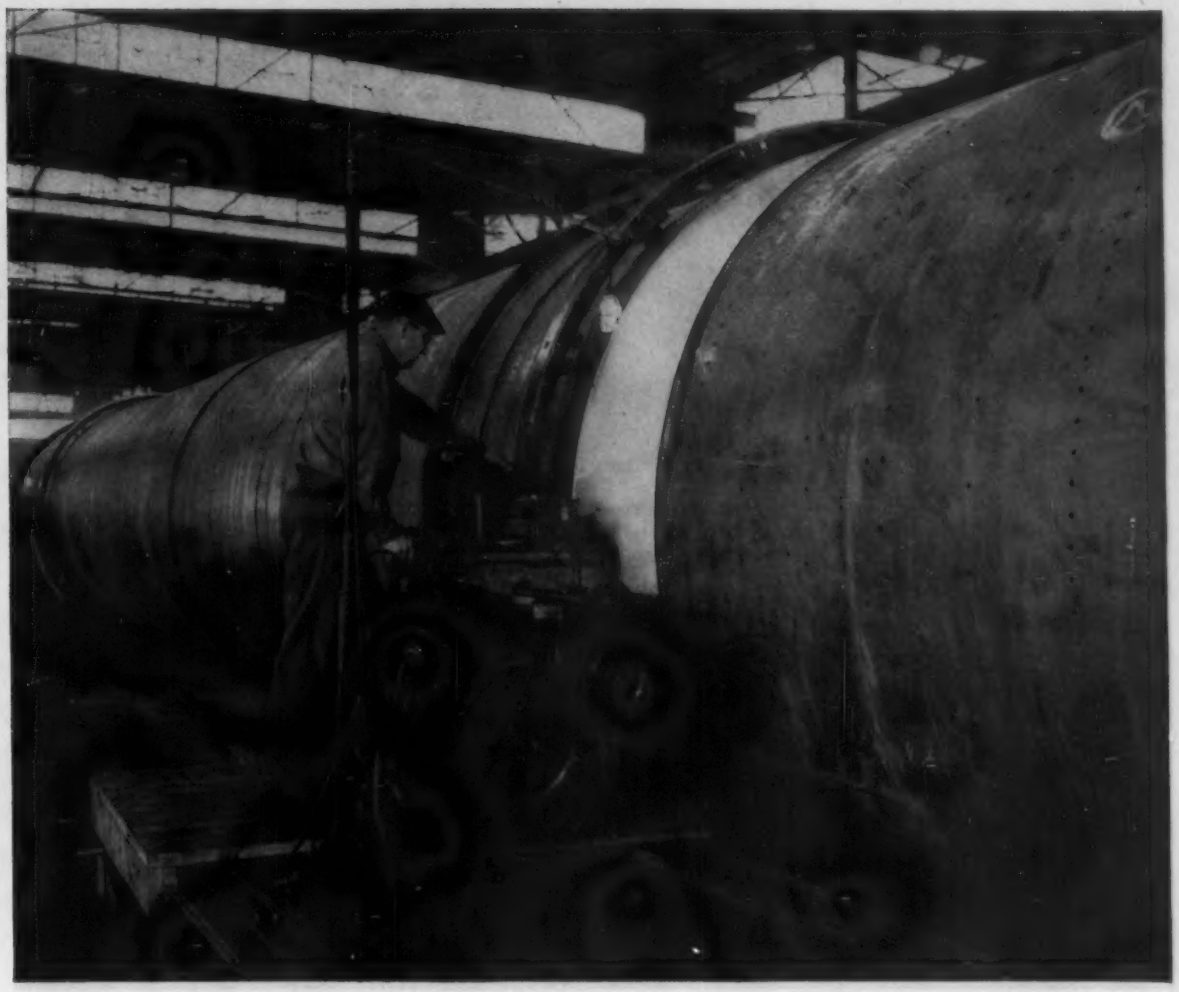

Louisville Dryer—10 feet in diameter, 10 stories long!

Turn a ten story building on its side, and there'd be room to spare on either end of this huge pit lathe at Sharon, Pennsylvania where this 10′ x 110′ Louisville Dryer was fabricated.

This lathe is used for machining the reinforcing bands onto which are mounted the forged steel tires. This careful workmanship assures concentricity of the completed dryer shell—a primary factor in efficient seal operation.

Every Louisville Dryer is especially designed, manufactured, assembled and installed for its specific task.

If you have a problem involving process equipment, call or write our equipment specialist in your area. Here, as in so many fields, you'll find IT PAYS TO PLAN WITH GENERAL AMERICAN.

Process Equipment Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street, Chicago 3, Illinois
Offices in Principal Cities
In Canada: Canadian Locomotive Co., Ltd., Kingston, Ontario

Louisville Dryers

Montana *(Continued)*

company officials said. The Great Falls plant has eight zinc units and is presently using five of them. One more will be brought into production to handle zinc concentrates which have been treated in Anaconda.

Approximately 175 men have been employed in the zinc plant at Anaconda. Throughout the Anaconda reduction works, about an equal number, mostly students, have been hired as extra help during the summer. Some of the men who have been on zinc will be transferred temporarily as replacements for students on the vacation relief jobs. Later, when additional ferromanganese furnaces are started in Anaconda, it is planned to use some of the men there, Mr. Renouard said.

He also said some of the Anaconda employees may go to Great Falls.

The U.S. Forest Service is examining the Black Canyon-Selway area of the Beaverhead National Forest to determine whether anyone is in actual possession of or engaged in working mining claims located before July 23, 1955.

The examination is the first step in the procedure set up by the new Multiple-Use Mining Law of July 23, 1955, to determine whether claims to surface rights are valid and effective.

The determination of surface rights on old claims in the Black Canyon-Selway area will in no way interfere with a claimant's right to prospect, mine and develop minerals, use the surface and timber on a claim for mining purposes or to patent his claim in accordance with the law. After a claim is patented, both surface and mineral resources become the property of the claim owner.

Formal public notice regarding the determination of surface rights on mining claims in the Black Canyon-Selway area will appear in local newspapers for nine consecutive weeks. In addition, a copy of such notice will be delivered to persons whose names and addresses are determined as provided in the new law. The owner of a mining claim located prior to July 23, 1955 will have 150 days after the first publication to assert surface rights if he chooses to do so.

In a talk before the Butte rotary club Aug. 6, Clyde E. Weed, chairman of the board of Anaconda Co. declared, "The district (Butte) can operate practically indefinitely on about the basis at which it is now running.

"In fact," the mining executive said, "to show our faith in this district we are now considering an investment of several million dollars in new underground work to make it possible to mine great quantities of ore which we know exist in the lower levels of the Butte mines." He did not elaborate but said that if the investment is made it will delay for a considerable period the sinking of the Ryan shaft. (Work was started some time ago on the Ryan and Missoula shafts in a new program known as the Northwest project but was postponed after copper prices began to fall sharply in 1957.)

NEVADA

Les Warfield is shipping large amounts of mercury ore from the Warfield properties near Ione in Nye County. Two truck-trailers, carrying 20 tons each, haul the ore to Los Angeles where it is treated by a new electrolytic retorting process. Values run 5 lb to the ton, and if the new process proves satisfactory, Warfield plans to install a similar electric furnace at Ione.

Nevada Mineral & Oils Corp. is shipping large tonnages of silver-gold ore from Tonopah to the U.S. Milling & Minerals mill at Silver Peak in Esmeralda County. The contract calls for delivery of from 3,000 to 7,500 tpm, according to Vic L. Smith, assistant manager of the mining firm. Ore is being mined from the Tonopah Belmont, North Star, and Tonopah Montana properties, all big producers in the early part of the century. Values in selenium are also present in the ore, and a selenium plant is planned at Tonopah. When completed, the concentrates will be returned to Tonopah for extraction of selenium.

Sierra Talc Co. is producing steadily from its property in western Esmeralda County. The firm has been producing good talc at the property for the last 20 years. Most of the production goes to the company's refining plant at Keeler, Calif.

Sheldon Lamb of Escalon, Calif. and Al Dickman of Manteca, Calif., have installed a 50-ton rotary furnace at their leased mercury mine in northern Nye County. Seven men are employed at the site under direction of Bob Chiatovich, and a recent shipment consisted of 14 flasks. Two retorts are now in operation as well as a new tractor and a new skiploader. The operators are leasing the property from Lahontan Mines Co.

Extensive diamond drilling operations have been completed by a Utah firm on the Consolidated-Virginia properties near Virginia City. Abe and Belle Kendall, leasers, plan to start operations at the site which figured large in the Big Bonanza era. The Kendalls acquired the lease in settlement of a judgment from Consolidated-Virginia Mining Co. of San Francisco.

R. J. F. Mining Co. has four men working on exploration of a property on the north fork of Twin River in Nye County. Values are mainly in lead and silver, with some gold and copper included. If tests indicate sufficient tonnages, the company plans to erect a concentration plant at the site. H. B. Jackson is in charge of the exploratory operations.

R. H. T. Dunsmore of Salt Lake City and H. G. Read of Montebello, Calif., have exposed a rich gold orebody approximately 500 ft long on the surface of their property in the Gold Circle mining district near Midas in western Elko County. Values are reported to go as high as 8.98 oz gold and 9.20 oz silver per ton. The operators are leasing the mine from O.D. Dibbern of Midas. Excavation work has followed an extensive exploration program.

Round Mountain Gold Dredging Corp. is producing a major portion of the Nevada gold output, according to the USBM. When the firm resumed operations at Round Mountain in Nye County after a winter shutdown, the state's gold output increased from 4,696 to 7,600 oz per month.

Kenard Mining & Milling Co. at Gabbs is treating 2.5 tph at its newly reconstructed mill. Six men are employed and the mill operates 16 hours per day, treating previously mined ores from the San Rafael mine 20 miles to the north-

LAKE SHORE, INC. of Iron Mountain, Mich., manufacturer of heavy equipment for the mining and shipping industries, is marking its 101st anniversary. The company was founded in 1858 as the Lake Superior Foundry Co. by Charles T. Harvey. Harvey also established the first wagon road between Lake Superior, Green Bay and Chicago (now the Chicago & North Western R.R. right-of-way) and planned the first New York City elevated. The early shops of the Lake Superior Foundry saw the invention of the first electric hoist for use in underground mining, automatic couplers on underground mine cars, and a hydraulically operated skip.

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All-New Nylon U. S. Royal Super Con-Trak-Tor with ...69% to 95% Longer Tire Life!

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Steel Reinforced Tread*

New S.R.T.—as shown here in the X-Ray photo—is a **tough** reinforcement of tread, shoulder and buttress areas. It consists of several thick layers of tread rubber containing thousands of short lengths of brass-coated steel filaments. This forms a virtually **impenetrable** mat between the tread and nylon cord body and extends down through the shoulder and buttress areas providing **positive** protection against combination cut-and-impact failures!

Add to exclusive Steel Reinforced Tread... 50% deeper tread at center... far deeper tread at shoulder... 25% more ground contact... Double-Strength Nylon and you have the world's **toughest** off-road tire! No wonder the great new U. S. Royal Super Con-Trak-Tor-S.R.T. outperformed **every** tire put against it—by the widest of margins—up to 95%! Can you afford less on **your** jobs?

U.S. ROYAL SAFETY 1st TRUCK TIRES

US RUBBER **United States Rubber**

ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Nevada *(Continued)*

east. Values in lead and silver average about $15 per ton, and large amounts of ore have been stockpiled near the mill. Dr. Paul C. Goddard of San Jose, Calif., and Gerald Kennedy of Gabbs, are partners in the operation.

Wabuska Chemical Co. and Nevada Thermal Power Co. are drilling test wells in the Hot Springs area north of Wabuska in Lyon County with the hope of producing sodium sulphate. In the 1930's the area produced large amounts of the nonmetallic substance, but operations ended when the price declined. Clark J. Guild, attorney for the developers, said a plant near Wabuska is planned. Guild, a Reno attorney, was interested in former operations at the site.

Research in electrolytic reduction of rare-earth metals, which led recently to experimental production of high-purity cerium by USBM metallurgists, will again be emphasized in studies during the 1960 fiscal year, the Bureau has announced.

In addition to the work in electrolysis, the Bureau is trying various solvent-extraction and ion-exchange techniques in efforts to develop a continuous process for recovering rare-earth metals from ores, concentrates and mill residues and separating individual rare-earth elements.

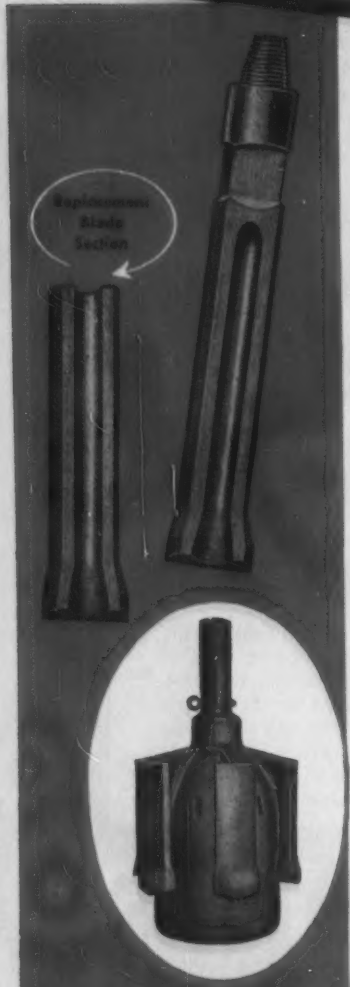
To meet the needs of its own research on high-purity metals, the Bureau is continuing an intensive quest for new and improved analytical methods that will detect and measure minute quantities of impurities in experimental products. Progress is being made also in developing and applying radiochemical and radiotracer techniques, which enable researchers to follow ores and metals through the different stages of a metallurgical process.

The Bureau's studies of rare-earth metals are performed at the Reno Metallurgy Research Center and the Albany Metallurgy Research Center, Albany, Ore.

SPANG

BLAST HOLE BITS

Drill More Holes Per Bit, At Less Cost Per Hole



SPANG CHURN DRILL BITS, famous for long life and economy in the drilling of blast holes for the fragmentation of minerals or overburden, drill *more-holes-per-bit* at *less-cost-per-hole,* because they are fully heat-treated from end to end and have the *extra strength in pin and blade sections* to stand up under the toughest drilling conditions. They are made with semi-dressed ends for quicker, easier finish-dressing, in High Carbon, A.I.S.I. 4340, and Spang Molloy Steel.

Available also, as an added economy, are SPANG REPLACEMENT BLADE SECTIONS in the same grades of steel, and uniform forge section, for welding to pin and collar sections of original bits when long service has worn the integral blade to a point where replacement is desirable.

Anyway you look at it, SPANG BITS are your best buy for more holes at less cost per hole.

SPANG REAMER TYPE PILOT BITS FOR DRILLING LARGE DIAMETER HOLES

Can be supplied in all sizes and in any practical weight.

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NEW MEXICO

Rio de Oro Uranium Mines, Inc. was granted the right to sell excess ore to others than Homestake-New Mexico Partners in a 10-page judgment closing one of the lengthiest and most complicated cases on record in the U.S. District Court of N.M.

The judgment gives Rio the right to sell ore to others than Homestake-New Mexico Partners after H-NMP has enough ore to fill its mill to capacity.

The suit was brought by Rio de Oro June 13, 1958 against Homestake Mining Co. Rio sought a judgment declaring rights and obligations of the parties under a limited partnership agreement, plus an accounting, injunctive relief and the imposition of a constructive trust. Involved as plaintiff-intervenors were United Western Minerals Co., J. H. Whitney & Co., White, Weld & Co., and San Jacinto Petroleum Corp. The limited partnership is comprised of Homestake Mining Co. as general partner; Rio de Oro, Clyde Osborn and the United Western as limited partners.

Kaiser Gypsum Co. will build a modern, highly automated gypsum product. plant at Rosario, near Albuquerque, adjacent to a high-grade gypsum deposit. Plans call for initial production to be underway by June 1960. The plant's rated productive capacity will be 120 million sq ft of gypsum board annually, or approximately 220 flatcar loads per month. The plant will serve a territory including New Mexico, Colorado, Oklahoma and parts of Texas.

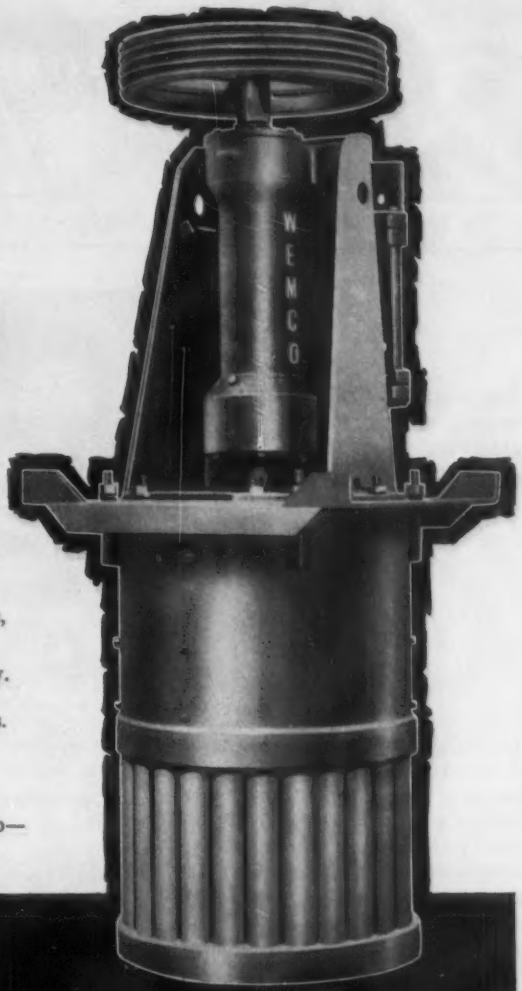
NORTH CAROLINA

Lithium Corp. of America announced Aug. 5 that it is moving its entire laboratory and manufacturing operations to Bessemer City from Minnesota, and that executive offices will be transferred from Minneapolis to New York.

The move, to be made this fall, will cost $800,000 including construction of offices and laboratory at Bessemer City and expansion of the $7-million plant built there five years ago.

With the consolidation, the Bessemer City plant will be the only one in the

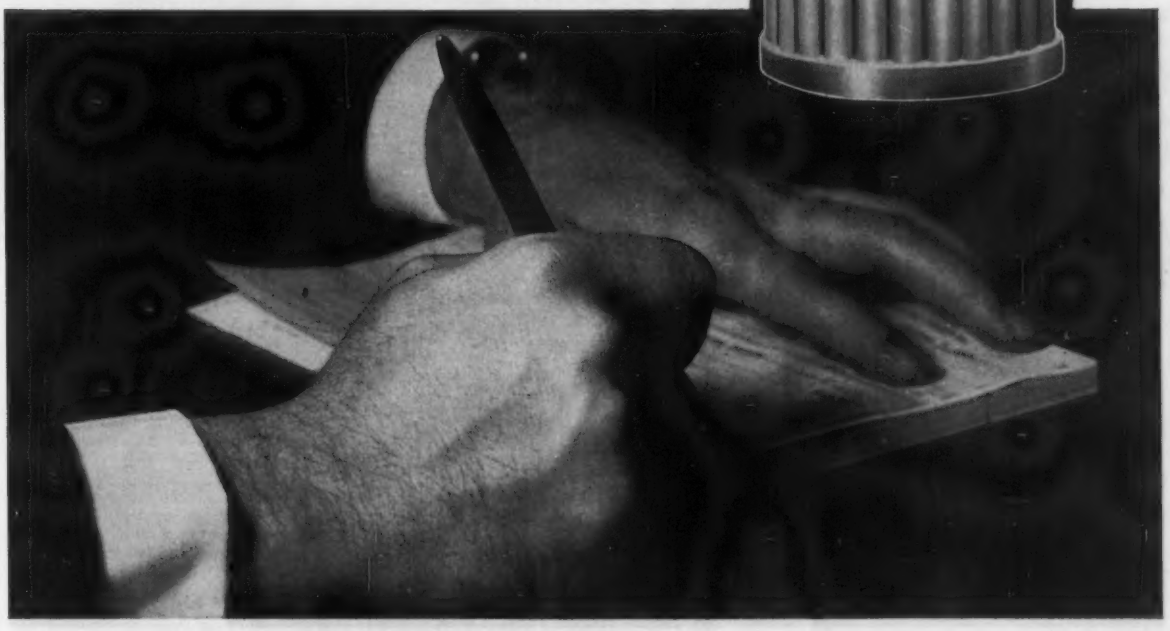
THIS DECISION WILL PAY BONUS PROFITS OF MORE THAN $6,500 EVERY DAY!



This order and installation of Wemco-Fagergren Flotation Machines by a leading coal producer will result in additional profits of over *$6500 per working day*— and for surprisingly low capital investment. Cost of the total plant addition, including the flotation cells, will be offset in less than four months.

This is another example of how Fags go to work—profitably. Recovery is consistently higher; floor space, maintenance and operating labor, reagent and other requirements are less.

The Wemco-Fagergren record of profit-producing installations tells the story of sound experience. The men of Wemco will be glad to furnish all the facts and discuss why Wemco-Fagergren Flotation will do a better job—where flotation has a place.



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and throughout the world

SIMPLICITY

screening methods for mines

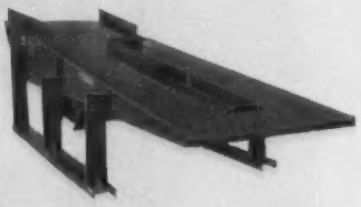
INFORMATION ON ORE PROCESSING EQUIPMENT

SCALPING IRON ORE WITH A PORTABLE STRIPPING PLANT IN MINNESOTA

In order to move from one area to another in the vast Minnesota Iron Range, this stripping unit has been mounted on crawlers and motorized. It's fed by a 25 cubic yard drag line, and an average of 2500 cubic yards of material passes through the 5' openings in the grizzly deck every hour, with some 250 cubic yards being scalped off. Heart of the operation is a Simplicity 7' x 12' Heavy Duty Scalper. This unit is one of many such powerful machines we have built for mining. The first were built on request for an engineering company that needed a higher scalping output than their standard stationary grizzlies could give them . . . since then, we have developed many models, and installed them in numerous mines where fast scalping or scalping plus feeding were required. If your operation involves the scalping of large heavy lumps from fines, write us for further information on Simplicity Scalpers.

VIBRATING PAN TYPE FEEDERS CONTROL FLOW OF ORE FROM BINS

The controlled feeding of ore from storage bins is a problem that finds a very apt solution in Simplicity vibrating pan type feeders. These units permit the discharging of ore at uniform flow rates and at the same time prevent bridging and holding up in the bin. They can be either mounted or hung from springs by cable. Another application for pan type feeders is for sizing ore while conveying it. In this case, we equip the pan with grizzly bars. With a grizzly feeder, some operators add a third job . . . washing . . . thus feeding, classifying, and cleaning their material with one unit. The Simplicity Vibrating Pan Feeders are very versatile machines, and have helped a good many mines . . . if you have a feeding or bin unloading problem, they can help you, too.



MANUAL REMOVAL OF FOREIGN MATTER IN MINING

Undesirable material cannot always be removed by screening alone; in many cases, the foreign and useful materials are the same size. In such operations, a Simplicity Picking Table, installed in conjunction with Simplicity Screens, can speed the removal of unwanted matter. Simplicity Picking Tables have gyrating decks, built on the incline, and act as conveyors at the same time that they provide work area for sorting. If you need a good method for the manual removal of shale, stone, or other material from ore, write us for recommendations.

TWO JOBS DONE WITH ONE DOUBLE-DECK SCREEN

A double-deck screen can perform two operations instead of one, by scalping on each deck and feeding the scalped material off to separate bins, while fines drop through to storage. The scalped material can then be utilized without further processing, or put through a crusher for reduction. In a midwest mining operation, a Simplicity Double-Deck 6' x 12' M-15 is scalping and grading the tough, abrasive, Taconite iron ore on an extremely fast schedule. Fines are retained, and the gyrating decks feed larger lumps to a cone crusher. The Simplicity machine operates 24 hours a day when necessary. For more details on these Double-Deck Screens, write for Catalog No. 53.

Write for information on any of these pieces of equipment or for Bulletin No. 53

SIMPLICITY ENGINEERING COMPANY

DURAND 4, MICHIGAN

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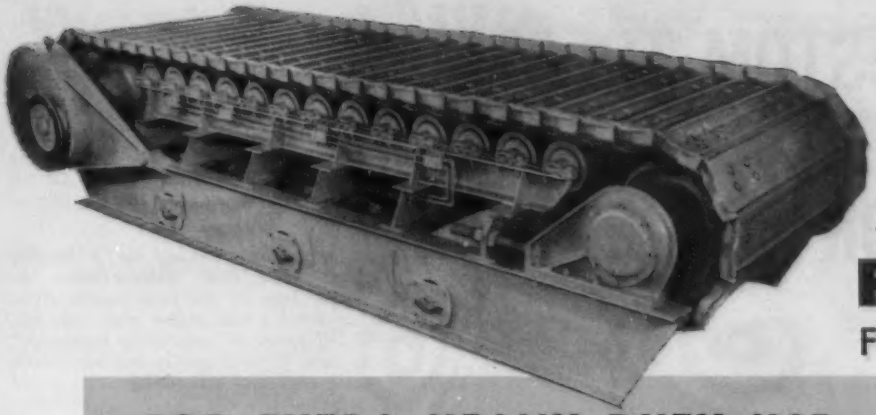

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FOR EXTRA HEAVY DUTY USE

- Uses Mass Produced Standard Crawler Tractor Parts
- Short Pitch, 8" on FD-8, 6-¾" on FD-4, provides more even feed.
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Write for free specifications catalog listing the most complete line of drop forged fittings for wire rope and chain.

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Every NFM FILTER CLOTH gets a treatment specifically designed to withstand the conditions it will meet on the job. Our cottons are specially impregnated to resist *acids* and *alkalies*. We treat our glass fabrics with silicones and Teflon for *abrasion* resistance. Our cottons and synthetics get the full treatment for *stability:* cold water shrinkage, hot water shrinkage, and heat setting. Nylon gets a dose of neoprene and Hypalon; glass fibres take vinyl shots for their health.

The longer the life — the lower the cost

Service life is the true measure of filter cloth economy. By selecting from the many NFM FABRICS the one that is *custom treated* to last longer in *your* filtration process, you save most where the costs are highest: by reducing down-time, change-over labor, and replacement. When the problem is tough, call the doctor for the NFM ECONOMY TREATMENT.

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Pensacola, Fla.: Chem-Quip Co., 1102 Texar Drive

North Carolina *(Continued)*

U.S. processing lithium from ore to finished products.

The move will also save the jobs of some 125 plant workers at Bessemer City who expected to lose them at the end of the year when Lithium Corp.'s five-year contract to supply lithium hydroxide to the AEC expires.

A contractor working on a housing development near Winston-Salem reported July 31 that well-digging crews had struck a vein of low grade gold ore, but it would be "practically impossible" to mine it commercially because it is in solid rock and the mining costs would be prohibitive.

H. D. McKnight, who once worked as an assayer in Colorado, said the first strike came at 116 ft in a well being drilled in early July. He said the drillers were "still in the vein" when they stopped drilling at 204 ft.

Gold again was discovered July 31 he said at 194-ft in a well being drilled a few hundred yards away. He said the vein appeared to run in an east-west direction and that the second strike apparently was part of the same vein discovered earlier.

Before the 1849 California gold rush, North Carolina was the country's major gold-producing state.

OREGON

Obtaining the right to prospect and hold claims on county lands in Oregon has been made easier by a law enacted by the 1959 legislature in Salem. County courts may now execute leases and contracts on a royalty basis for mining of valuable minerals without necessity of competitive bidding and public advertisement. Lands to be leased for oil and gas must still be submitted for bids and advertised for two successive weeks.

Suksdorf placer in the Mormon Basin district of Baker County is being worked by the Oil-Minerals Operation Co. of Tulsa, Okla. A dragline-washing trommel set-up is being used with water for the operation being pumped from the old Humboldt mine.

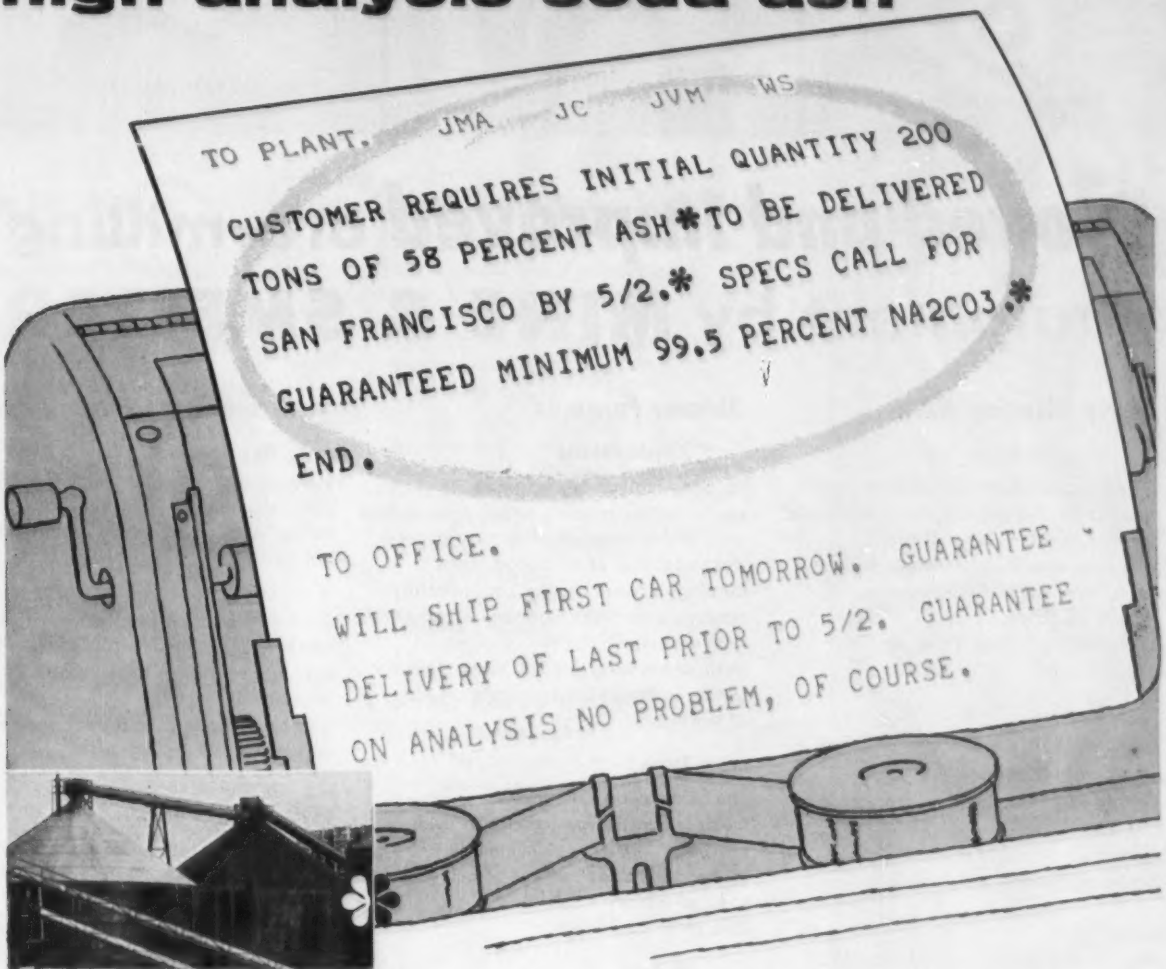
F. A. Ramsey, A. M. Rowe and Assoc., Sumpter, are using a 7-in. giant for hydraulic placering in the Cracker Creek channel below Bourne, Baker County. A dozer and slusher assist for boulders.

Frank Mayo, Sumpter, has leased a group of placer claims on Burnt River above Whitney and has set up a 75-yd per day skid-mounted washing plant. The claims are upriver from a large tract dredged by Murphy-Sunshine interests prior to World War II.

Charles Griffin, Durkee, has developed a high bar placer on Burnt River below Cave Creek in Baker County for hydraulic placering. The bar was drift-mined in the early days.

W. W. Serrine and W. W. Decker,

West End "fills the order" for high analysis soda ash


TO PLANT. JMA JC JVM WS
CUSTOMER REQUIRES INITIAL QUANTITY 200
TONS OF 58 PERCENT ASH* TO BE DELIVERED
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GUARANTEED MINIMUM 99.5 PERCENT NA2CO3.*
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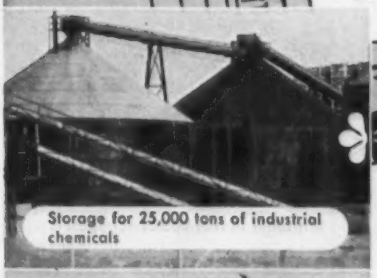
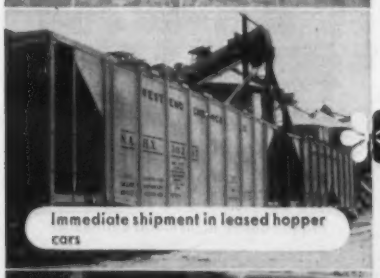
WILL SHIP FIRST CAR TOMORROW. GUARANTEE
DELIVERY OF LAST PRIOR TO 5/2. GUARANTEE
ON ANALYSIS NO PROBLEM, OF COURSE.


Storage for 25,000 tons of industrial chemicals


Immediate shipment in leased hopper cars

Constant control for uniformly high quality

Meeting service requirements to the letter and producing superior soda ash of consistently accurate particle size and chemical analysis are the essentials to which the West End organization is uniquely geared. A system of rapid communications linking our sales office in Oakland with our production, technical and shipping departments at the desert plant site permits each department head to have a complete understanding of the customer's individual requirements and to make firm commitments or provide the desired information promptly.

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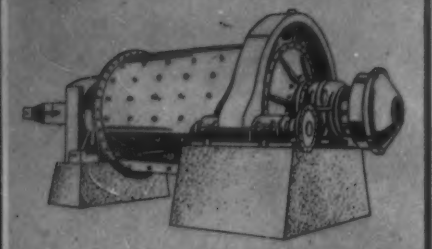
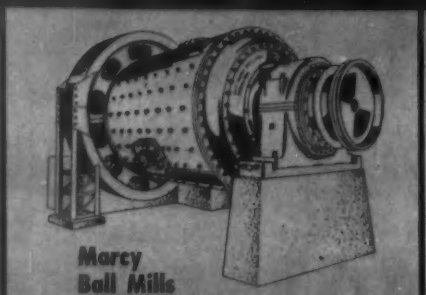
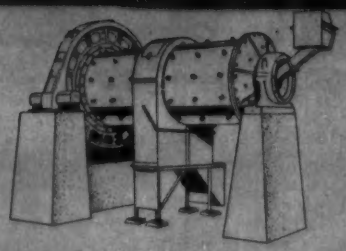


Marcy Rod Mills



Marcy Ball Mills



Marcy CPD Rod Mills

Proved and Improved ore-milling equipment by MINE & SMELTER

Marcy Grinding Mills

Applications

Grinding materials 1½" or finer to a product as fine as 325 mesh; materials such as metallic ores, industrial minerals, specification sands, cement, brick, lime, coke, clay, chemicals, fibrous materials.
Wet or dry grinding. Open or closed circuit.

Types

Grate discharge & overflow type ball mills.
Open end rod mills.
Center and end peripheral discharge rod mills.
Tube mills — Pebble mills
Acid-proof mills — Batch mills

Sizes

29 different diameter sizes, from 12" to 12'6" inside diameter.

Capacities

Up to 6650 tons per 24 hours per mill

Skinner Furnaces

Applications

Roasting molydenum sulphide concentrates; roasting uranium-vanadium ores; drying uranium oxide precipitate; decomposition of oil sludge; lime burning; drying copper concentrates; roasting zinc ores; manganese reduction; dehydration of alunite; calcining of basic alum, lime sludges, clays, foundry sands, carbon, etc.; incineration of sewage.

Types

The Skinner is a cylindrical, multiple hearth type furnace, providing maximum flexibility, minimum dust losses, and the advantage of being able to handle sticky materials.
Gas, oil or coal fired.

Sizes

2 to 12 hearths
4'0" to 23'6" inside diameter
22 to 4000 sq. ft. hearth area

Massco-Grigsby Pinch Valves

Applications

For handling corrosive and abrasive pulps and liquids; and where remote control and/or automatic regulations are desired.

Types

Available with rubber, neoprene, or specially compounded rubber sleeves.
Manual and power driven closing mechanisms.
Can be equipped for remote control and automatic regulation.

Sizes

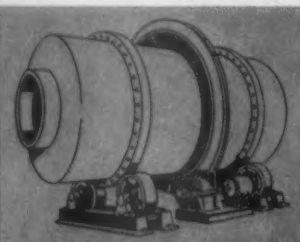
1" to 14" inside diameter.

Capacities

Pressures to 150 psi.
Temperatures to 200° F.

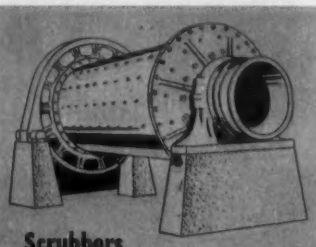
Specialized engineering and laboratory testing services available for ore-milling problems.

Burt Filters

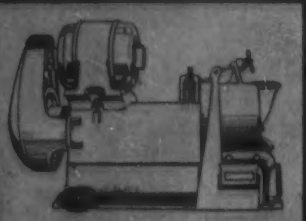


Fusion Furnaces

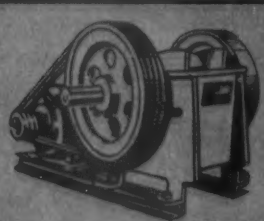
Leaching Drums



Scrubbers



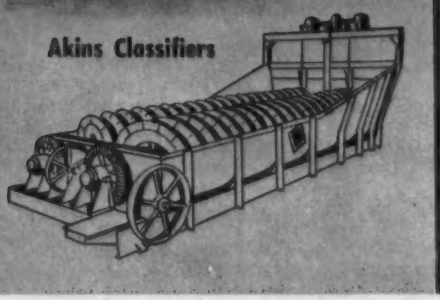
Massco-McCool Pulverizer



Massco Lab Jaw Crusher

Licensed Manufacturers and Sales Agents in Canada, Australia, Sweden, England and South Africa.

Sales Agents in Chile, Peru, Philippine Islands, Japan, New York City (for Continental Europe), and in the principal cities of the United States.



Akins Classifiers

Akins HMS Separators

Akins Densifiers

Esperanza Drag Classifiers

Skinner Roasters and Dryers

Wilfley Tables

Massco-Grigsby Rubber Pinch Valves

Marcy Pulp Density Scale

Akins Classifiers

Applications

Classification of solids by size and/or gravity.
Dewatering.
Washing ore, coal, oyster shell, sand and gravel.
Desliming and deoiling phosphate rock and concentrate.

Types

Standard, simplex and duplex, for size separation, or dewatering, of coarse material.
Submerged spiral, simplex or duplex, with large pool, for separation of finer sizes.
Flared tank units provide maximum setting area and reduced overflow velocity.
Special units for handling acid or caustic solutions and salt brines.
Lifter bars and spray water box arrangements are available for difficult washing problems.

Sizes

12″ to 84″ spiral diameter, simplex and duplex.

Capacities

Sand raking capacity: up to 7860 tons per 24 hours (Duplex machine)
Overflow capacity: up to 2386 tons per 24 hours (Duplex machine)

Akins Heavy Media Separators

Applications

Any material that is amenable to heavy media separation of its components, such as coal, iron, manganese, fluorspar, chrome, lead-copper, tungsten, garnet, topaz, gravel.

Types

The two basic types of Akins Separators are modifications of the standard and submerged spiral Akins Classifiers.

Sizes

Spiral-diameter sizes from 12″ to 84″.

Capacities

Sink: up to 230 tons per hour.
Float and middling: up to 290 tons per hour.

Akins Heavy Media Densifiers

Applications

Used for recovering and cleaning medium solids.

Types

The Akins Densifier is a modification of the submerged spiral Akins Classifier.

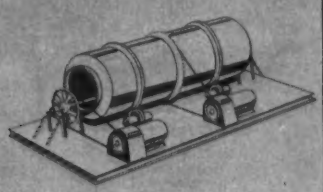
Sizes

Spiral-diameter sizes from 16″ to 66″.

Capacities

Raking capacities up to 49.5 tons per hour.

For Complete Information ...on these and other *Proved and Improved* **Mine and Smelter products, write for catalogs.**

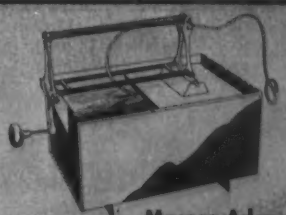


Pug Mills

Vezin Sampler

Massco Gy-Roll Reduction Crusher

Lab Crushing Rolls



Massco-Adams Reagent Feeder

Manufacturing Division

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EL PASO
P.O. BOX 1162

Oregon *(Continued)*

Salt Lake City, and Robert Hulin, Baker, are erecting a small flotation mill to process ore recovered last year in development work of a molybdenite-copper prospect in the Rock Creek district of Baker County.

Tailings from the mill of the old Cornucopia gold mine in Baker County are being used for concrete mix and grout at the Idaho Power Co.'s Brownlee and Oxbow dams on the Snake River.

Operations at the Warner gold mine in Jackson County were discontinued May 1. Frank Gelhaus, Rogue River, operated the mine between 1954 and 1959. It produced small amounts of high grade gold ore. A. M. Ropp and J. C. Wells, Albany, own the mine.

Earle Young and Walter Lonnon have cleaned out No. 1 and No. 2 tunnels at the Humdinger mine in Josephine County and installed a small mill. Equipment includes a crusher, ball mill, amalgamation plates, a table and a small cyanide plant.

Zinc Creek Mining Corp. has added equipment to the old Waldo Milling Co. mill on French Flat and is running a mill test on about 75 tons of material from a mineralized zone on the Zinc Creek logging road about 10 miles northeast of Tiller in Douglas County.

The Gray Cinnabar property in the Coyote Hills, Lake County, has been leased to Albert Schiermeister, Frank Melvin and others of Grants Pass.

The Bonanza quicksilver mine in Douglas County is again in full operation. Tom W. Bidwell Jr. is the new mine superintendent. Development work is currently being carried on at the 1400 level.

A new adit is being driven at the Buffalo Mine at Granite by Boaz Mining Co. The new working adit is designed to intercept veins at a depth of approximately 230 ft below the present lowest level. When completed the tunnel will be approximately 1400 ft long and will intercept all known veins on the property. Since World War II the Buffalo Mine has been Oregon's top lode gold producer.

Gold Star Mining and Milling Co., Baker, has a crew at work diamond drilling at the Phoenix mine near Greenhorn in Grant County.

Upper workings of the Bay House mine, an old silver lode on the Snake River below Huntington, have been reopened by Franz & Traver of Ritzville, Wash. Some exploratory drifting is planned.

T. D. French, Spokane, who recently purchased the lease on the consolidation of the Columbia, E & E, Tabor Fraction and North Pole mining properties in the Cracker Creek mining district in Baker County, has put a crew to work at the Columbia mine and on renovating jobs at the mill.

The Tri-County Mining and Milling Co. mill in John Day has been leased by Cobalt-Gold Mines, Inc., of Boise, Idaho, which has been milling gold ore from a company owned property on Dixie Creek north of Prairie City in Grant County.

SOUTH CAROLINA

Tidewater phosphate mining made a comeback near Beaufort as the first mining operations in over half a century opened in the Coosaw River area in September.

Richard G. Pollitzer, secretary of the Beaufort Mining & Development Co. said a new process for tidewater phosphate would make profitable mining possible and add a major export item to the Port Royal ocean terminal.

Leroy H. Keyserling, vice president of the mining firm, said Martin Decker of New York, head of Decker Laboratories, had studied the phosphate situation and laid initial plans for extracting commercial quantities of phosphate for chemical and fertilizer use by a process developed and patented by Decker. Details of the process were not disclosed.

The Beaufort group will be required to pay only a 2% royalty on mined phosphate instead of the flat $2 per ton levy made on earlier miners.

TENNESSEE

The rush for land in the East Tennessee Zinc district continues unabated. Latest purchase is the mineral rights on the 285-acre River Hill Dairy farm near Mascot, by American Zinc, Lead & Smelting Co. Knox County Court House records show the purchase price was $35,731.25.

Cessation of the Government purchase of manganese ore for stockpile on August 5 was expected to shut down the entire manganese district near Elizabethton. Local miners expect the price for high grade ore to drop from $120 to $56 per ton.

Of the six operating companies in the Elizabethton area, only two, Tri-State Mining Co. and U. S. Sulphate and Manganese Co., plan to continue production for a short period.

Foote Mineral Co., which recently purchased Electro Manganese Co. in Knoxville, is starting a $200,000 expansion program. According to W. D. Morgan, Foote's manager of the electromanganese operation, the expansion will be primarily to increase high purity manganese output plus the construction of a new laboratory.

Rep. Howard Baker (R. Tenn.) reports that a bill he introduced to equalize tax exemptions for small and medium sized mines has a "good chance of passage before Congress quits."

House Ways and Means Committee has unanimously approved the bill, which amends a section added to the Internal Revenue Code in 1951 to stimulate metal and mineral production for the Korean war.

The 1951 section allowed firms to deduct up to $100,000 a year for any four years for the cost of exploring for new mineral deposits. As administered, says Baker, it has been very unfair to the smaller companies.

Expenditures by the smaller firms of as little as $1,000 a year have been interpreted to exhaust one year of the four years for which exploration deductions were allowed, he said.

Cancellation of that year also entailed loss of the other $99,000 in annual deductions that would have been allowed had the smaller firms been able to afford the expenditure.

Baker's bill leaves the original $400,000 ceiling in effect, but strikes the four-year limit, so that smaller firms can enjoy the same benefits over a longer period of time that the big firms could accumulate in four years.

TEXAS

An expansion of the Reynolds Metals Co. dock and loading facilities at the company's Sherwin alumina plant near Corpus Christi, costing more than $1-million, was announced by W. Monroe Wells, vice president of operations. Construction of the facility, which will introduce a number of new concepts to that type of loading operation, including pneumatic conveying, is expected to begin in early fall, Mr. Wells stated. It will be located about 500 ft from the present Sherwin plant dock.

The project calls for a 450-ft long installation with a concrete dock and piles, a 9,000-ton capacity storage silo for alumina, a hopper car unloading facility and 270-ft long electrically operated conveyor system. With the expanded facility, it will be possible to load tankers with alumina at the rate of 600 tph.

A new talc mill and the first one to be built in the Hudspeth County Talc District is under construction at Allamoore. Located on the T&P railway and U.S. Highway 80, the mill is also within five miles of the Southern Pacific track. According to M. Woodard Glenn, president of the Pioneer Talc Co. of Chatsworth, Ga., the flowsheet will include a Jeffrey hammer crusher, two Raymond roller mills, Double-Whizzer air classifiers and a Raymond mechanical air classifier, special grit throw-outs, Tyler Hummer screens, and St. Regis bagging machines. Pioneer will mill talc from its own deposits and also undertake custom milling. First unit is scheduled for operation in November.

UTAH

"The first major silver-lead-zinc find in Utah in the last 25 years" has been made by Bear Creek Mining Co. in explorations in the Tintic district, according to Cecil Fitch, Jr., president of Chief Consolidated Mining Co., Eureka.

The Chief, with the Tintic group of

YOU'RE AHEAD

because the specialized experience of two pioneer companies in front-end loaders is now combined . . .

ALLIS-CHALMERS
—pioneer of the world's first successful hydraulically-controlled crawler-mounted tractor shovel.

result of 14 years' leadership

TRACTOMOTIVE
—one of the first to develop heavy-duty rubber-tired loaders.

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Now Tractomotive Corporation has become part of Allis-Chalmers . . . and that means we'll be able to serve you better than ever. One very important reason is that the specialized experience of each organization in its field cannot be surpassed.

Allis-Chalmers pioneered its history-making HD-5G in 1945 . . . has led the field in crawler shovel design and performance ever since . . . now offers the most complete line of such equipment in the industry, with bucket sizes from 1½ to 7¼ cu yd.

The Tractomotive team has been building heavy-duty wheel loaders since 1948 . . . has consistently pioneered developments of great value to users, including torque converter drive and single-lever shifting control.

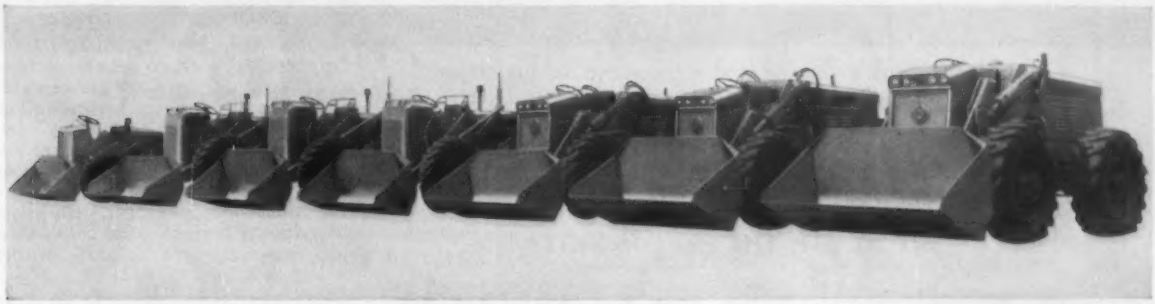
Through the combined facilities of these two pioneers, we offer you industry's most complete line of front-end loaders, on rubber or tracks . . . with these added basic advantages to back it up!

- another modern plant joins Allis-Chalmers' extensive facilities for manufacturing construction machinery
- a company-wide record of engineering leadership in all types of heavy-duty equipment
- widespread research activity that insures continuing progress
- original factory parts and blue-chip parts control
- increased man power in sales and service

See 'em at work—your Allis-Chalmers dealer will be glad to demonstrate the machine of your choice—wheel or track-mounted, whichever meets your job needs best. Just give him a call. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wis.

YOU'RE AHEAD **with a TRACTOLOADER** ...a complete line now built and backed by Allis-Chalmers

Seven models—34 to 130 hp—up to 9,000-lb carry capacity. Torque converter drive in every model.



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EVERY diamond is of uniform size, shape and structure throughout; hand picked from thousands with a skill born of 68 years in this highly specialized business.

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J. K. SMIT & SONS, INC.
HOME OFFICE AND PLANT
MURRAY HILL NEW JERSEY

Utah *(Continued)*

companies (Salt Lake City), is a partner in the Tintic unit operated by Bear Creek, domestic exploration affiliate of Kennecott Copper Corp.

Western Knapp Engineering Co. has been awarded a contract to engineer major portions of the $10-million improvement and modification program at the Kennecott Copper Corp.'s Garfield smelter.

The San Francisco firm's bid proposes conversion of present pre-roasting process to direct smelting (green firing of concentrates); modernization of materials handling; enlargement and modernization (through high arch construction) of three reverberatory furnaces and installation of new waste heat boilers.

Automatic dumping will replace present clamshell unloading of concentrates. The reverbs, in addition to being enlarged, would have their present sprung arch, silica-brick roofs replaced with suspended-brick roofs.

KCC acquired the Garfield smelter Jan. 1, 1959 from American Smelting & Refining Co. It is the world's largest capacity smelter.

WASHINGTON

Sunny Peak Mining Co., Spokane, has resumed work at its Mohawk mine in the Conconully district of Okanogan County. E. I. Fisher, secretary of the firm, said that work has been started by A. L. Davidson, of Conconully, on a contract basis. Crews are extending the No. 3 lower tunnel in an effort to find the downward continuation of an ore shoot which yielded some silver-gold-copper-lead-zinc ore to a former lessee of the higher No. 2 tunnel.

WYOMING

L. B. Worthington, president of U.S. Steel's Columbia-Geneva Steel Div., announced that engineering designs have been substantially completed for the proposed taconite ore processing facility near Atlantic City.

The designing phase in the development of the proposed project was done by Bechtel Corp. of San Francisco.

Mr. Worthington emphasized that there still has been no definite decision that Columbia-Geneva will proceed with development of the iron ore reserve or with building of the refining and beneficiation facilities that will be required because of the low iron content of the ore.

General contractors have been asked to review the designs so the corporation may evaluate future potential of the project, Worthington said.

Personnel of the Union Pacific R.R. have surveyed the right of way for a 76-mile spur line from the main line of the U.P. to the site, which would be used to haul ore from the property.

Federal Uranium Corp.'s uranium processing mill being constructed in the

"*Angeline*" Rounds Out 2nd Year of Service. Meet "Angeline"—a Bethlehem-wire-rope-equipped dragline excavator, the latest addition to the coal-stripping equipment operated by Pennweir Construction Co., Weirton, W. Va. This mine is rounding out 21 years of continuous service near Florence, Washington County, Pa. The excavator was photographed recently on 62-ft overburden with a 33-cu-yd drag bucket. The twin hoist lines, each 477 ft long, are 2⅛ in. 6 x 41 improved plow steel, lang lay, IWRC. The twin draglines, each 285 ft in length, are 2⅝ in. 6 x 25 Type W, improved plow steel, lang lay, IWRC. Despite long and hard usage, both types of Bethlehem rope have been providing excellent service—the kind that gets the job done at the lowest possible cost.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem Wire Rope

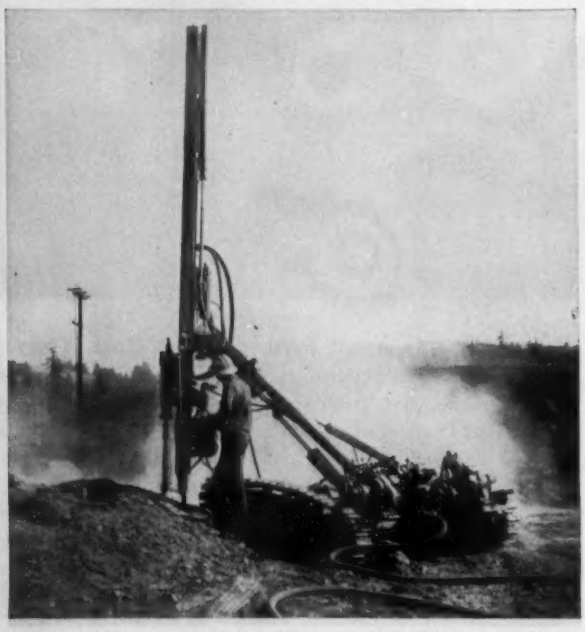
BETHLEHEM STEEL

HARD-HITTING DRILLS

THE SIZE, THE POWER AND

5 ½″ hammer diameter—Here's deep hole drilling power that packs plenty of punch. Gardner-Denver DH143 fills the rock drill gap between wagon drill and rotary rig.

Tough and long-lasting—Gardner-Denver drill steel. Emergence from heat-treat furnace shows carburizing process that results in abrasive-resistant exterior and tough inner core.



First choice in crawler drills—The versatile swing-boom "Air Trac"®. Now available in a variety of models including stiff- and swing-boom units with complete hydraulic components.

FOR ANY ROCK BLAST

THE SPEED YOU NEED

Select your rock drills from the most complete line of drifters in the field . . . GARDNER-DENVER

Gardner-Denver offers the most complete range of drifter drills known, thus assuring the right drill for your application, regardless of what it may be.

Talk to a Gardner-Denver blast hole specialist before you buy new rock drills. His experience can help you select the best blast hole plan and the right equipment for the job from Gardner-Denver's complete line of drills, rigs, steel and accessories.

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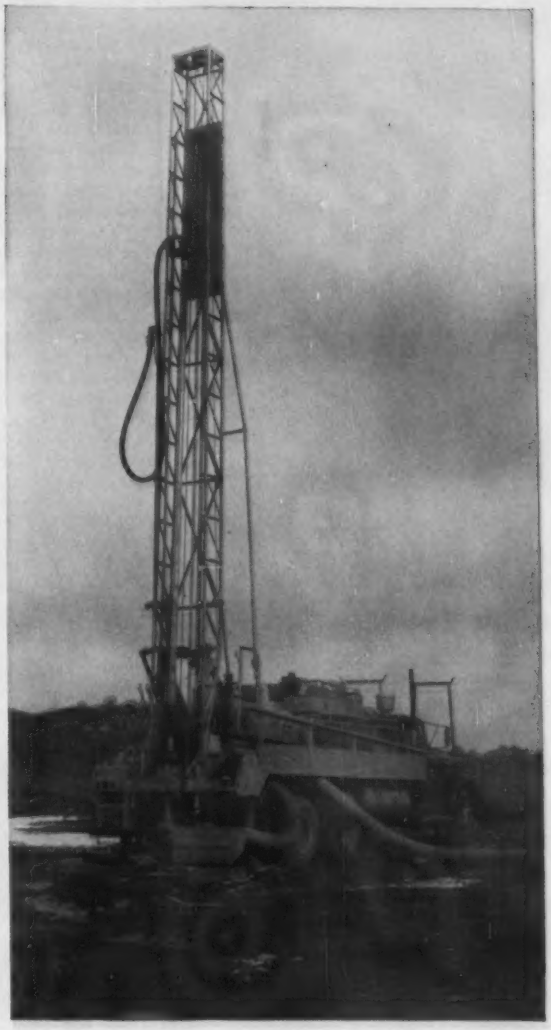
When unexpected developments demand immediate attention (additional equipment, essential parts, special service), a Gardner-Denver man is ready to go—any time, anywhere. And at Gardner-Denver, there's no substitute for men—our 100-year philosophy of growth.



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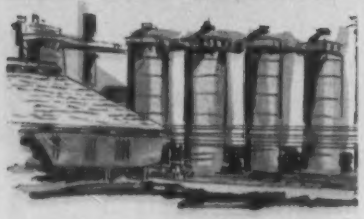

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Wyoming *(Continued)*

Gas Hills area is about 35% completed and is expected to be on stream late this year. Federal is the managing partner with Radorock Resources, Inc., and Gas Hills Uranium Co. in the mill. In Riverton Federal reported to stockholders that it had a net income of $486,853 for the past fiscal year.

Western Nuclear Corp. has announced it will increase its mining crew with start up of operations on the deep portion of its Frazier-Lamac orebody in the east Gas Hills area. The main orebody is expected to be encountered at 275-300 ft. First phase of the Frazier-Lamac stripping operations will have moved 6-million cubic yd of earth. The stripping project will total 18-million cubic yd, it is estimated.

The Western Nuclear mill, shut down at midnight, June 1, when the Government milling quota for the year was reached, reopened Aug. 1.

Although a few workers were laid off, most were transferred to other related jobs or given vacations during the time the mill was closed.

During the shutdown, Western Nuclear had been expanding its facilities to allow for the increased tonnage provided by its new contract with the AEC, presiden Robert W. Adams said.

A contract for stripping 1.6-million cubic yd of overburden has been let to L. H. Weber, Rawlins, Wyo., by the Federal-Radorock-Gas Hills combine. The huge kidney shaped pit is in the east Gas Hills on the Buss claims, south of the Redwood pit of Two States-Valley Dean. The pit will be stripped by mid-October it is reported. Average depth stripped will be 160 ft.

J. H. Pomeroy Co., San Francisco, has been awarded a contract of $1.5-million for partial construction of Globe Mining Co.'s new 492 tpd uranium mill in the Gas Hills area 75 miles west of Casper. Total cost of the mill is about $3-million.

Pomeroy has started work on construction of employee facilities, consisting of a bunkhouse, service building to house administrative offices, dining hall, and recreation center. Foundation work for the mill was started in May by the Witt Construction Co., Provo, Utah.

Pomeroy started work on the mill building in August. The mill is expected to be in operation by January 1960. Strip mining operations, under the supervision of I. R. Taylor, will be carried on near the mill site as well as on Globe's mining properties about 12 miles away. Globe Mining is a unit of Union Carbide Corp.

A $100,000 uranium ore upgrading plant has been completed in the Gas Hills area by International Mining Co., Greenville, Ohio, and American Mills, Inc., Dallas. Located 55 miles east of Riverton, the plant is designed to improve low grade uranium ore to the point where uranium oxide can be extracted commercially.

IN CANADA

BRITISH COLUMBIA

Disclosure that Wenner-Gren B.C. Development Co. will run its railway west of the Rocky Mountain Trench from somewhere north of Prince George to the Yukon border, in the general direction of Alaska, has aroused much interest and speculation in mining circles in B.C. Cassiar Asbestos Corp. has its mine near Watson Lake on the Alaska Highway making it a logical way-point on a railway route. The major mineral wealth of the region lies in central B.C., which would tend to swing the route to the west, away from the Trench. Start of the railroad is scheduled for spring of 1960.

Vimy Explorations Ltd. has started exploration on its 24-claim group adjoining Torwest Resources' Aberdeen property. Drilling was started after removal of 60,000 tons of overburden.

Giant Nickel Mines Ltd. has received a firm offer for unlimited quantities of nickel and copper concentrates from a Japanese firm, and shipments are expected to start early in 1960, after the company fills its present short-term (to December) contract to ship 8,000 tons of nickel concentrate to the Sherritt-Gordon refinery at Fort Saskatchewan. If the offer is accepted, the company will begin shipments to Japan in February. First load will be between 2,000 and 3,000 tons.

New Privateer Mines Ltd., reports that surface exploration indicates high grade copper over good widths within 1,500 ft of the main gold veins on its Zeballos property on Vancouver Island. Engineering and geophysical studies and diamond drilling will ascertain the potential of the copper showings.

Silver Standard Mines Ltd. has rejected an offer of $1-million for its iron ore claims in the Queen Charlotte Islands. The company has started a diamond drill program at its Moresby Island iron property. The ninth of a 50-hole program is currently being drilled. Silver Standard's annual report showed working capital of $558,583 at March 31. Current assets totalled $566,597 and current liabilities $8,014. A magnetometer survey has been carried out to the McMillan property on Moresby Island and indicated a potential of some 750,000 tons of direct shipping grade.

Bulolo Gold Dredging Ltd. reports a net profit of $650,000 for year ended May 31, compared to $403,000 last year. Value of gold produced this year totalled $704,900, a drop from the $837,865 of 1958. Some 20,140 oz of fine gold were recovered from the 4,855,605 yd dredged. Gold recovered in the three month period ended May 31, was 4,698 oz from the 1,153,600 yd dredged.

Transcontinental Resources Ltd. has acquired property with high grade gold-

NOW the EUCLID "TWIN" Scraper has EVEN MORE POWER* and WORK-ABILITY!

*Now 563 total h.p.!

No other scraper gives you all the features you get in the TS-24 "Euc"

- 2 engines— 563 total h.p.
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- 32 yds. heaped (24 yds. struck)
- 27.00x33 tires (33.5x33 optional)

Euclid's TS-24 Scraper, with power increased to 563 h.p., now widens its lead in performance over every other scraper in the field. With a 336 h.p. engine in the tractor and 227 h.p. at the rear, this "Twin" is unsurpassed in productive capacity.

On job after job—small grading work to big yardage projects—the TS-24 Twin-Power "Euc" moves dirt at lower cost than other scrapers.

Its big power, big capacity and big performance has helped contractors, mines, quarries and industrial users to beat the pinch on profits.

Have a Euclid dealer show you how the "Twin" can bring a better return on investment . . . on your present or future work. He'll give you all the facts and can probably arrange a demonstration for you.

EUCLID Division of General Motors, Cleveland 17, Ohio

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The Dynaclone has *new* "Resist-O-Wear" filter bags (patent pending) that give as much as three times longer bag life . . .

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And it contains more cloth per cubic foot of filter than any other make . . . greater filtering capacity with smaller space requirements.

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British Columbia *(Continued)*

silver-lead-zinc ore next to the mill site of its subsidiary Sunshine Lardeau Mines. The company reports a working capital of $170,141, compared with $110,267 in the previous year.

Rexspar Uranium & Metals Mining Co. is negotiating to obtain funds to finance production from its B.C. uranium prospect in the Birch Island area. Preparatory construction work was carried out on the plant site last year. Reserves are intact and estimated costs of production are low. Also planned is development of the company's fluorspar deposit estimated at 2-million tons. An open pit operation supplying an industrial chemical plant is envisaged. Total of 37 claims was staked adjoining an optioned 32-claim group at Foghorn Mountain.

ONTARIO

Moose Mountain mine and taconite plant of Lowphos Ore, Ltd., subsidiary of the M. A. Hanna Co., shipped its first car of ore in May of this year. The mine is located 15 miles north of Capreol, Ont. Stripping, plant and building construction were begun in 1957, but delayed by the 1958 recession.

Steep Rock Iron Mines, Ltd. had shipped 901,380 tons of ore as of June 30 this season as compared to 172,735 tons to June 30, 1958.

Steel Company of Canada has announced plans for increasing its plant capacity at Hamilton, Ont., by almost 25%. The improvements will raise capacity from 2.35-million tons per year to 2.9-million tons. Since its incorporation in 1910, it has produced over 34.5-million tons of steel. Included in the program are a new 300-ton capacity open hearth furnace, a new 250-ton pouring crane, enlargement of present mill buildings, addition to the dock area and other changes and improvements. Since Pickands, Mather & Co. operates iron ore mines for Stelco, the increase in capacity of the steel plant will require additional iron ore from PM&O mines.

Three diamond drills are being employed by Stewart Lake Iron Mines of Ontario Ltd. in the initial phase of a development program to prove up an iron orebody. The deposit indicated by exploration work to date on its two properties is near the iron project of Anaconda Iron Ore (Ontario) Ltd. in the Lake Nipigon district. Work is under direction of International Mine Services Ltd., exploration-development arm of the Joseph H. Hirshhorn financial interests.

Acquired from Panther International Mining Co. Ltd. earlier this year, the Stewart Lake properties are contained within two large claim groups identified as the Stewart Lake zone and the Summit Lake zone.

Shaft sinking at Taurcanis Mines Ltd. is now complete to 670 ft with two new

NO STUCK STEELS

WITH THE NEW LE ROI DUSTLESS AIR LEG DRILLS

NEW "DUSTLESS" AIR LEG drills dry, fast and clean. Cuttings are drawn through the hollow drill steel and chuck housing into the LX-1 dust box which is emptied by remote control lever on the drill throttle valve.

Steels never stick when they're on the business end of the *new* Le Roi LLV Dust-Collecting Air Leg Drill. The dustless drill melts its way through the hardest rock — piles up more drilling footage with a lower dust count than was ever possible with wet drilling.

Dry, dustless drilling permits continuous ore sampling — saves every speck of precious ore. It eliminates the need and expense of water — does away with wet, dangerous conditions; sinking pillars; lost holes; water and muck haulage.

The LLV collects dust through the drill steel and exhausts it through the chuck housing — *not the machine!* It's ideal for mining or tunneling in hard rock — saves tools and operators.

Ask your Le Roi distributor for a demonstration. Or for more information, write to the Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wis.

LE ROI NEWMATIC® AIR TOOLS

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

AT-907

Ion Flotation Wins Metals From Solution

A PATENT application has been made in the U.S. and 31 other countries by Armour & Co.'s Fatty Acid Div. on a new metallurgical process—ion flotation, a process that may pave the way for the recovery of nonferrous metals from such solutions as mine waters and dilute leach liquors. Process was developed by Prof. Felix Sabba, Witwatersrand University, Johnnesburg, South Africa, and has been viewed in some quarters as a cheap way to win metals from the sea.

Armour, after much bigger game, considers the sea water deal interesting, but is directing research toward mine water applications. Basically the process is the same as mineral flotation, except that no mineral is involved, only the metal ions in solution. Soap, with an affinity for certain metals or metal groups, is bubbled through the metal-bearing solution where the soap reacts with the metal ions to produce a water-insoluble heavy metal soap which floats to the surface and is skimmed off with other soap bubbles.

Survey of the literature on the heavy metal soaps reveals little or nothing about their reactions with each other—by soap is meant the derivatives of the fatty acids, including the amines. The definition of ion flotation could be enlarged to include not only the soaps, but any frother-collector combination that would produce a concentrate from ions in solution. The possibilities are almost unlimited.

Armour hopes to find soaps that will be selective. Two approaches are open. One is to find selective hydrocarbon soap partners. The other is a bit more difficult, but ideally more desirable, and that is to take advantage of the electromotive series of metals (redrawn at the left from "Electrons & Ions", April 1958, E&MJ).

Metal	Ion
Li	Li^+
Cs	Cs^+
Rb	Rb^+
K	K^+
Ba	Ba^{++}
Sr	Sr^{++}
Ca	Ca^{++}
Na	Na^+
Mg	Mg^{++}
Al	Al^{+++}
Be	Be^{++}
U	U^{++++}
Mn	Mn^{++}
Zn	Zn^{++}
Cr	Cr^{+++}
Fe	Fe^{++}
Cd	Cd^{++}
In	In^{+++}
Tl	Tl^+
Co	Co^{++}
Ni	Ni^{++}
Sn	Sn^{++}
Pb	Pb^{++}
H_2	H^+
Sb	Sb^{+++}
As	As^{+++}
Bi	Bi^{+++}
Cu	Cu^{++}
Hg	Hg^+
Ag	Ag^+
Pd	Pd^{++}
Pt	Pt^{++}
Au	Au^+

For example, suppose that for economic reasons and availability, we were to choose stearate as our hydrocarbon partner and try to form a soap selective to copper in mine water. Looking through the electromotive series we can see that a lithium soap would be useless, since lithium would react with every element in the table. Aluminum, further down the list would be somewhat better since it would eliminate the alkali and the alkali earth metals; but it would still react with many undesirables in the series.

Lead, antimony and arsenic soaps would produce a much cleaner concentrate; but bismuth, just above copper, would appear the perfact soap, since it would react only with copper in acid mine water. One stumbling block in this approach is the relative insolubility of the heavy metal soaps (below magnesium) in water. The reagent soaps could be dissolved and diluted and fed with an alcohol or mineral spirit or blended with a wetting agent that would remain soluble in the solution and not contaminate the product. In the past, mining companies have tried many ways to recover copper from dilute mine water, including ion exchange, without much economic success. Perhaps ion flotation is the answer.

Ontario *(Continued)*

levels established at 475 and 625 ft, it was reported. The shaft intersected the Matthews vein at 625 ft where double stations were established. Visible gold was observed in the backs and faces of both stations officials say, and sampling and mapping of the vein is now proceeding.

Lateral work is underway and will be concentrated largely on the 325 and 625 levels developing the Matthews vein and the South zone. There are 10 different known gold occurrences on the property, according to J. C. Byrne, vice president.

QUEBEC

Mid Chibougamau Mines Ltd. has announced part of its 1959 exploration program, localized on 13 claims in Garson Twp, Sudbury area, under arrangements with Westville Mines Ltd., had produced interesting possibilities in the copper-nickel district.

Electromagnetic and magnetometer surveys, conducted on the property, outlined four main zones. The four electromagnetic anomalies indicate zones of strong electrical conductivity which may be due to highly persistent sulphide mineralization or wet faults. The conductors correlate with anomalous areas outlined by the magnetometer survey. Drilling is to be undertaken immediately to test the zones.

SASKATCHEWAN

Rix-Athabaska Uranium Mines, Ltd. has an extensive exploration program in progress, both on its original Beaverlodge property and on the claims recently acquired from the Pardee, Amax and Aurora groups. Foreseeing a possible end in the reserves of its Smitty workings some time this summer, the company has been seeking a replacement for the ore suitable for treatment in the custom mill of Lorado Uranium Mines, Ltd.

The program includes further diamond drilling in the lower levels of the Smitty shaft, surface mapping and drilling in areas reachable from the Smitty and Leonard workings, as well as investigations of favorable geological structure elsewhere on the property.

IN LATIN AMERICA

ARGENTINA

Salta is the fourth Argentine province where rich uranium bearing ore reserves were established and which as a consequence will get its own processing plant, Dr. Pedro N. Stipanicic, head of the geological and mining department of the National AEC, announced.

So far some 200,000 tons of uranium ore were estimated for the province, containing uranium of over 0.1% per ton.

Argentine geologists have explored an area of 51.2-million acres in the provinces of Mendoza, San Luis and La Rioja, and have investigated some 1,200 mining establishments for uranium content. Proved reserves in the provinces

High-speed Michigan Dozer expands practical crusher feed distance to 400′

Nevada firm reduces handling costs 25%

Nacon Company, Inc is a Las Vegas firm that *doesn't* take chances when buying equipment. "Gambling belongs in the casinos!" says Tom Stewart, president of Nacon. "Before *we* lay out $50,000 or so for any big dozer, we *demand* on-the-job demonstrations.

"Our latest demonstration really proved profitable. In the hopes of boosting crusher-feed production, we tried a rubber-tired Michigan Dozer. The output of this rig really surprised us. Tests showed the 375 hp Model 380 could push enough material to our crusher to produce 400 tons of spec stone per hour—*even at distances up to 400 feet.* No competitively-priced rig came close to this production. We talked it over with our Michigan Distributor, Graid Equipment Company . . . and bought!"

The Michigan's first job was on a 9-mile excavating-grading-structures section of new four-lane blacktop Federal Interstate Highway near Las Vegas. Here, Nacon's contract called for several hundred thousand tons of roadway base and sub-base gravel (3,250 lb/yd) in three grades—select bankrun, #1 and #2 stone. Michigan's share was to dig out and push all this material to the crusher. It did . . . at an *average* work speed of 3 to 7 mph!

Production up 20 to 30%

Output averaged 400 tons per hour . . . 20 to 30% higher than Nacon's estimates with other machines . . . at a per-ton cost "about 25% lower." And since the high-speed Michigan could economically work longer distances, Nacon didn't have to move the crusher as often as with crawler-feeding. One set-up handles as much as 315,000 tons.

Bud Jacobsen, operator of the Model 380, likes the Michigan for more reasons than high production. "For one thing, it's easier riding," says Bud. "Tires absorb bumps and ruts so you can work faster on rough going. Second, you sit higher . . . have a better view of blade and of ledge and hopper edges. Third, Michigan handles easier . . . you change speeds and direction simply by moving little hydraulic levers *and without foot-clutching.* Its ease of handling, plus greater speed, adds up to *greater production than any crawler at any distance over 50 ft!*"

Output like this, day in and day out, speaks well of Nacon's job planning . . . also proves Michigans have what it takes to speed dozing and loading. See for yourself! Pick the rubber-tired Michigan Dozer you want to see, 162, 262, 375, or 600 hp . . . then ask your Michigan Distributor for a demonstration.

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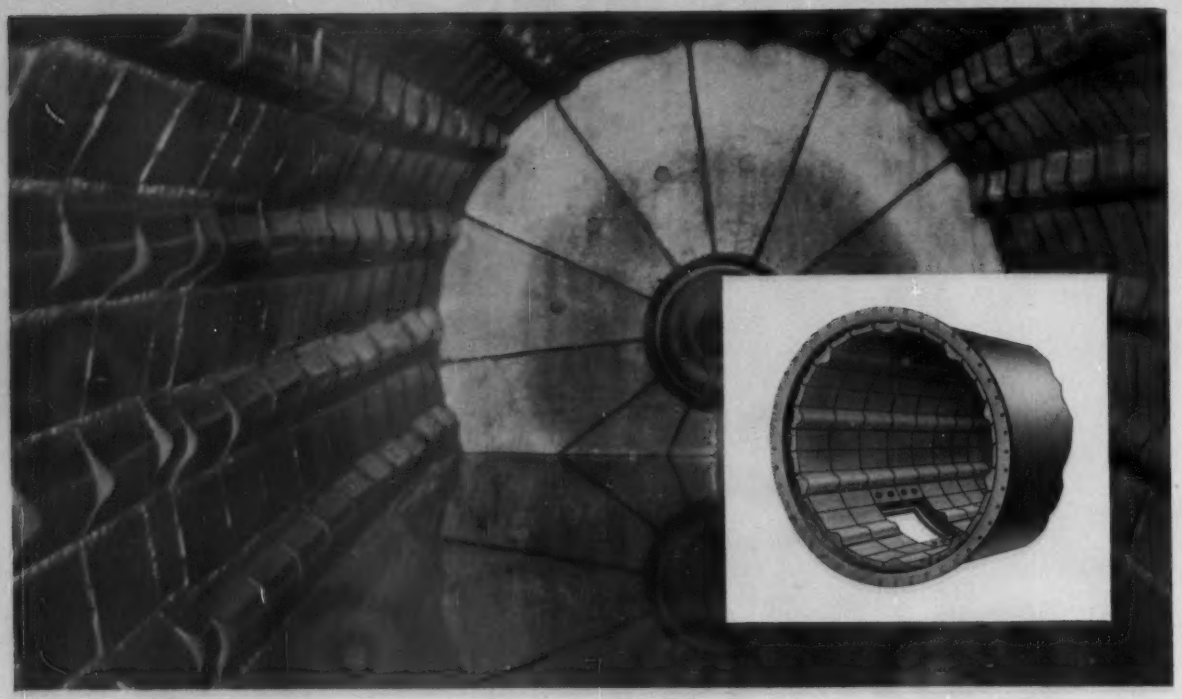

8 Reasons Why You Should Standardize with B&W Universal Liner Plates

Better Performance with Lower Costs—Same Casting Fits All Mill Sizes

B&W Tube Mill Liners reduce capital, time and labor costs. Consequently, they reduce the cost of the material ground. Here are eight reasons why:

1. Lower Initial Costs—standardization eliminates chiller and pattern costs.
2. Longer Life For Liners—better quality control on a mass production casting, utilizing permanent molds, results in uniform wear. Ideal size for uniform chill and heat-treatment.
3. Longer Life for Different Applications—this is assured by selection of proper materials. Design is suitable for either chilled irons or wear steels.
4. Reduced Costs in Both Direct Labor and Outage—installation time is less because small size and weight of castings allows them to be handled easily, without cranes and with less fatigue for workers.
5. Reduces Costs in Storage Space—because small castings stack easily, little storage space is required. One design of casting interchangeable for all size mills also simplifies records.
6. Reduced Costs in Liner Inventory—standardization is possible because one design fits all diameters of mills. Standardization means quicker unloading and storage.
7. Reduced Costs on Breakage Claims and Delays for Replacements—small castings are rugged and almost impossible to break by handling. Large castings of hard, brittle irons sometimes break in shipment.
8. Reduced Costs in Determining Most Efficient Wear Patterns—you can get wear profiles consisting of all lifter ribs or all flats from the same castings, as well as a combination of both including straight or spiralled lifter pattern.

Liners are supplied in two nominal thicknesses, 1½″ and 3″ with 1½″ high lifters. Castings are 6″ wide x 12″ long. Positive seating of small castings on mill shell means less breakage of castings under operating conditions. For additional information on B&W Universal Tube Mill Liner Plates write The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

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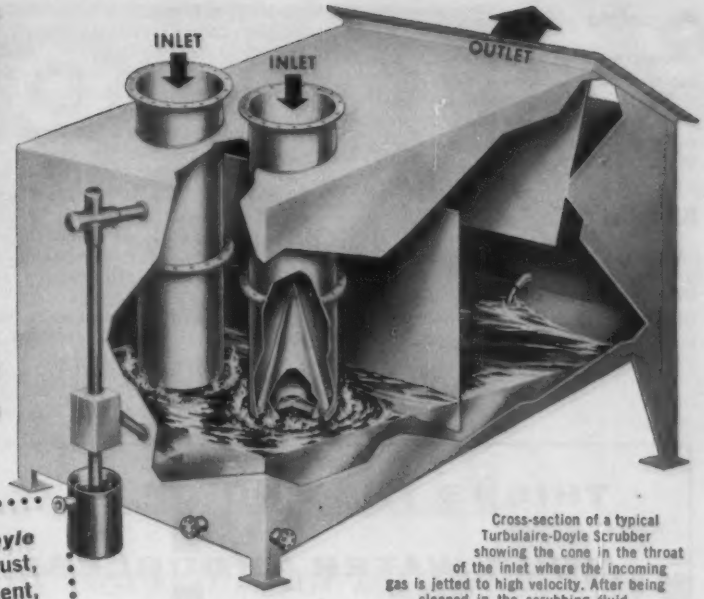

Cross-section of a typical Turbulaire-Doyle Scrubber showing the cone in the throat of the inlet where the incoming gas is jetted to high velocity. After being cleaned in the scrubbing fluid, the gas passes over spray eliminator baffles before it is discharged. Collected material is carried away by the circulating scrubbing liquid—is recovered as a liquid concentrate or slurry.

With addition of the Turbulaire-Doyle Scrubber to its line of advanced dust, fume and fly ash collection equipment, there is no industrial gas cleaning problem that Western Precipitation cannot handle with equipment of its own design. This assures your dust and fume control problem receiving the benefit of the industry's most complete "know-how" in all phases of gas cleaning operations.

The Turbulaire-Doyle Scrubber — a development of The Consolidated Mining and Smelting Company of Canada Limited and widely used in its own diversified operations — is now made available to industry by Western Precipitation Corporation under a license arrangement with Cominco.

Actual plant records, compiled over long periods of service, show the Turbulaire-Doyle Scrubber to be unique among commercially-available scrubbers in the multiple advantages it offers...

★ *High Collection Efficiencies* — generally 97% to 99%!

★ *Fine Particle Collection* — including those in the fume range!

★ *Low Liquid-to-Gas Ratio* — only 1 to 5 GPM per 1000 CFM!

★ *Wide Application Flexibility* — readily adaptable to various types of corrosion-resistant materials!

SIMPLE, TROUBLE-FREE DESIGN

The Turbulaire-Doyle Scrubber impinges dust-laden gas at high velocity into a bath of scrubbing liquid. The high velocity forces the gas and dust particles to penetrate deeply into the liquid for complete wetting and cleansing. A cone in the gas inlet nozzle, just above the surface of the scrubbing bath, provides the jetting action that assures outstanding performance from this unit. *There are no moving parts, nothing to require frequent maintenance!*

If you have dust or fume control problems where scrubber types of collectors are applicable, it will pay you to investigate the *years-ahead* advantages of the Turbulaire-Doyle Scrubber. Write, wire or phone the Western Precipitation office nearest you for further details.

· TYPICAL APPLICATIONS INCLUDE:

Cleaning Gases from sintering machines, blast furnaces, roasters, dryers, calciners, crushers, screens, ventilators etc., in a wide range of chemical, metallurgical, rock products, and waste disposal operations.

Cooling and Humidifying Gases from fertilizer, acid, carbonating, smelting, alloying, and reclaiming operations where cool, moist gases are necessary for proper processing.

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
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Argentina *(Continued)*

amount to 300,000 tons so far, according to Dr. Stipanicic.

The National government has set aside 85-million pesos (about $1-million) for exploration and development works in Salta province.

BRAZIL

With the completion of building construction at the Usina Hidrelectrica da Cachoeria do Franca, on the Rio Juquia, Companhia Brasileira de Aluminio will install new electrolytic furnaces. Usina Hidrelectrica has a present capacity of 30,000 kw. Companhia Brasileira de Aluminio expects to go into production with a 10,000 ton annual aluminum capacity, beginning in December 1959.

Companhia Estanifera do Brasil has increased its facilities to turn out 10,000 tons of tin for 1959. Brazil's tin production in 1955 came to 1,700 tons. In 1957 it rose to 2,300 tons. The present installed capacity will support a production of 4,000 tons. Companhia Estanifera is the largest Brazilian producer.

Increasing from zero production in 1955, Brazil expects to produce 10,800 tpy by 1960, it was reported. A zinc plant is going up in the town of Nova Iguacu in the state of Rio de Janeiro, which will have an initial capacity of 7,200 tons. It is scheduled to begin operation during the second half of 1959.

Lead consumption in Brazil in 1960, as an outgrowth of the requirements of the new automobile industry, will be 40,000 tons according to latest reports. It is at present about 25,000 tons annually. Production target for 1960 has been set at 18,000 tons. Expansion of the Companhia Acumuladora Prest-O-Lite, located in the Reconcavo da Bahia, estimates its 1958 production of metallic lead at 7,200 tons. It aims at 14,000 tons in 1959 and foresees 18,000 tons in 1963, according to reports.

In 1960, it is expected that 12,780 tons of copper concentrate, 8,000 tons of electrolytic copper and 3,000 tons of metallic copper will be produced. In 1955 the country produced only 730 tons of metallic copper. Work is progressing to expand capacity of the Companhia Brasileira de Cobre to enable it to raise its production of copper concentrates in 1960 to 12,780 tons; at Vicosa, in the northeastern State of Ceara, a plant is being built to produce metallic copper at the rate of about 3,000 tons annually.

Nickel production in Brazil is about 200 tons of pure metal. In 1955 Brazil produced 275 tons of ferro-nickel alloy. Its 1957 output raised the available ferro-nickel to 307 tons, equivalent to 70 tons of contained nickel. The Companhia Niquel do Brasil, the nation's only producer, with facilities in the State of Minas Gerais, has undertaken an expansion program to raise its production capacity. Its 1958 output is estimated at 150 tons. Consideration is being given to the installation of a new plant in Niquelandia, State of Goias, the state in which the new capital is being built.

CHILE

Chilean nitrate production reached 1,263,000 metric tons of nitrate during the 12 months ended June 1959. During the same period 1,230,000 metric tons of nitrate and iodine were sold for $44-million. The U.S. imported 484,000 metric tons followed by 170,000 tons to Spain, 82,000 tons to France, 50,000 tons to Egypt, 48,000 tons to Brazil, 34,000 tons to Argentina, 33,000 tons to Sweden and 30,000 tons to Portugal.

It is expected that production of nitrate will raise during the next 12 months and that sales will reach 1.3-million metric tons. It is reported that Red China is interested in buying 10,000 tons of crystallized nitrate for £150,000, which would be paid through the Bank of Paris. Corporacion de Ventas de Salitre y Yodo is studying the Chinese proposition.

The Eximbank recently raised from $16- to $20-million the loan conceded

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B-80L: 3" hose; 6 hp; 185 lbs; 330 GPM; max. head 170 ft.
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B-150/200L: 6" or 8" hose; 65 hp; 1,200 lbs; 3,000 GPM; max. head 220 ft.

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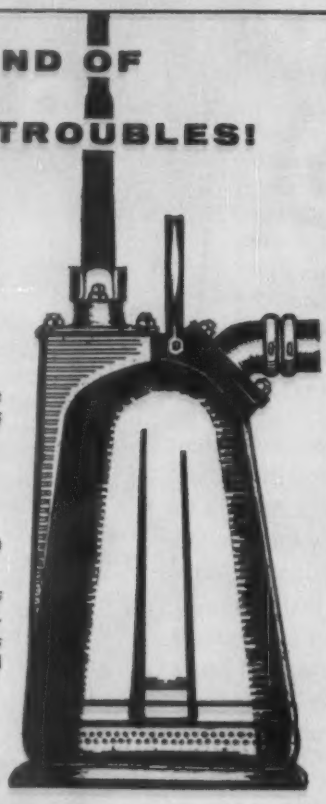

B-38L data: 1½" hose; 1.8 hp; 79 lbs; 75 GPM; max. head 90 ft.

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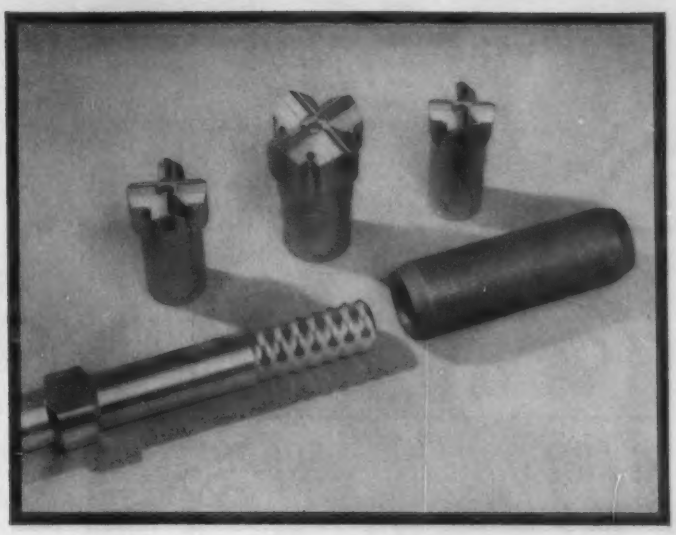

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"Up to double the footage between sharpenings!"
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"Bit and rod life are well above average!"
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**Names of men quoted available on request*

The comments above are actual quotes from project managers, job superintendents, and drill superintendents who have tested new Coromant rope-thread bits and steels. They've learned, on-the-job, the benefits they—and you—can expect!

For example: The new rope-thread (only two turns per inch) holds tight in use, yet permits hand uncoupling. Reports show that the time saved results in more footage drilled per shift. Bit footage is well above average too, with less loss of carbide inserts. Prime quality ore plus nickel-chrome alloy permits cold-rolling from billets for greater strength, life and rigidity. And only with Coromant rope-thread steels can you re-thread without heat treating, too. Do it yourself, or at any nearby machine shop.

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Chile *(Continued)*

to Compania Salitrera Anglo Lautaro in 1956. The total of $20-million will be due for payment in 13½ years. About $10-million will be spent for the expansion and modernization of installations. Another $10-million will be invested in the construction of a plant for production of iodine, boric acid and salt cake; construction of a mechanized port at Tocopilla and acquisition of five diesel electric generators. The loan will allow the company to expand operations, raise production of nitrate and start production of additional chemical products which were formerly neglected.

In line with its plan for development of the arid and poor northern zone of Chile, the Alessandri government will concede a special loan to Cia. Salitrera de Tarapaca y Antofagasta. The loan will be used to update equipment and methods. Improvement of nitrate production will also help the Alessandri economic plan to raise the country's foreign currency income.

Production of four U.S.-owned copper mines for the first half of 1959 rose 37% above 1958 for the same period. Chuquicamata, Potrerillos, El Salvador and El Teniente turned out 242,487 metric tons during the first six months of 1959, as compared with the 176,821 metric tons produced in 1958 for the same period. The 1959 production breakdown for the four mines is as follows: Chuquicamata—132,964 tons, Potrerillos and El Salvador — 20,913 tons, El Teniente—88,610 tons.

The estimated production of Anaconda (Chuquicamata, Potrerillos, La Africana) and Kennecott (El Teniente) for 1959 is 489,140 metric tons. If reached, the estimated production will be only 700 tons below the peak production of 489,906 tons for 1944. Estimated production of other than U.S.-owned copper mines for 1959 is 48,000 metric tons.

Cia. Minera de Taltal has started work in the Los Marios mine, five miles from the Taltal Railroad and 34 miles from the port of Taltal. All ore produced will be sold to Canadian Foreign Development Co.

John Ellis Dahlstron of the U.N. has arrived in Chile to visit the provinces of Coquimbo, Atacama, Antofagasta and Tarapacá where the present administration proposes to carry out a thorough geological investigation of the four mining provinces. The provinces have yielded about 90% of Chile's mineral wealth in the past. Chile hopes to carry out the geological work with the help of the U.N. The administration will spend about $152,000 in improving the mining roads in the provinces of Atacama and Coquimbo.

The French company of Peñarroya now has control of the Disputada and Zaita copper mines and mills which mill respectively 750 and 1,100 tpd. Because of its control of Zaita, Peñarroya also owns the Chagres copper smelter in central Chile which closed down in 1945. Peñarroya will spend about $700,000 in opening the smelter and camp. Mill concentrates now go to Tacoma.

DOMINICAN REPUBLIC

Two highways are under construction to increase mineral extraction in the Dominican Republic. A short highway through the mountains, Caballero-El Mogote, will permit exploitation of the El Mogote iron mine. El Mogote will begin using the $500,000 highway soon. Another highway from Las Lagunas-Cotui-Frias, costing about $1-million, will shorten the distance from the Hatillo mine to the sea, easing exportation of iron ore from Dominican ports.

IN AUSTRALIA

Queensland state minister for mines Ernest Evans said that more than £A1-million ($2.25-million) has been spent by Commonwealth Aluminium Corp. on preparatory development of the vast bauxite deposits at Weipa, on Cape York Peninsula in north Queensland.

Commonwealth Aluminium, a private

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Project personnel include: Boyd C. Paulson, project manager (above); Steve E. Wilmoth, general supt.; Paddy O'Dowd, Jack Robertson, and O. "Heavy" Holman, tunnel supts., Utah Const. Co.; Harold Barber and Neville S. Long, engineers, Southern California Edison Co.

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BUCYRUS ERIE

U_3O_8 Outlook

(Continued from p 19)

He noted the AEC contract permits additional runs of ore at Commission request over the pounds provided in the contract. He said Ureco was at present running ore above prescribed levels at the request of the agency so as to provide markets for independent millers.

First purchase contract signed between AEC and Ureco was on June 1, 1955 and the mill delivered its initial concentrates at Moab in Nov. 1956. Counting the existing contract fullfillment and the extended contract, Ureco will deliver an estimated $286-million worth of uranium to the government by Dec. 31, 1966. The old contract would have expired March 31, 1962.

E. H. Snyder, Salt Lake City, is chairman of the board and of the executive committee of Ureco. Richard A. Young, St. Louis, Mo., is executive vice president. Charles A. Steen of Moab is an important stockholder who originally conceived the mill based on his discoveries in the Big Indian district.

• **Meanwhile,** the Commission discloses that in some cases it is figsting deadlines in extending existing mill contracts into the 1966 period.

One contract, that of Kerr-McGee Oil Industries, Inc. at its 300-tpd mill at Shiprock, N.M. expires Oct. 31, 1959. The AEC will not confirm reports that the mill will be closed.

Climax Uranium Co.'s 330-tpd mill at Grand Junction, Colo. has a contract expiring July 31, 1960. But AEC has not yet completed contract signing on the bulk of its existing commitments in terms of the 1966 extension.

Firms with sales agreements expiring March 31, 1962, include: Anaconda Co., 3,500-tpd mill; Grants, N.M.; Dawn Mining Co., 400 tpd; Ford, Wash.; Gunnison Mining Co., 200-tpd from Gunnison, Colo.; Homestake-New Mexico Partners, 750 tpd, Grants, N.M.; Mines Development Co., 400 tpd, Edgemont, S.D.; Rare Metals Corp. of America, 300 tpd, Tuba City, Ariz.; Trace Elements Co. (Union Carbide) 300 tpd, Maybell, Colo.; Union Carbide Nuclear, 1,000 tpd, Rifle, Colo., (includes up-graders at Green River, Utah and Slick Rock, Colo.); Union Carbide Nuclear, 1,000 tpd, Uravan, Colo.; Vanadium Corp. of America, 750 tpd, Durango, Colo.; Vitro Uranium Corp., 600 tpd, Salt Lake City.

Contracts going past March 31, 1962 but not through to Dec. 31, 1966, include: Homestake Sapin Partners 1,500 tpd, Grants, N.M.; Lakeview Mining Co., 210 tpd, Lakeview, Ore.; Susquehanna-Western (formerly Fremont Minerals) 500 tpd, Oct. 31, 1963, Riverton, Wyo.

Contracts signed through Dec. 31, 1966, including Ureco at 1,500 tpd, Moab are: Kermac Nuclear Fuels, 3,300 tpd, Grants, N.M.; Lucky Mc Uranium Corp., 980 tons, Fremont County, Wyo.; Phillips Petroleum Co., 1,725 tpd, Grants, N.M.; Texas-Zinc Minerals Corp., 1,000 tpd, Mexican Hat, Utah; Western Nuclear Corp., 845 tpd, Jefrey City, Wyo. New mills under construction with 1966 contracts include: Federal-Radorock-Gas Hills Partners, 522 tpd, Fremont County, Wyo.; Globe Mining Co. (Union Carbide), 492 tpd, Natrona County, Wyo.

Yet to be signed in expansion of milling: mills for Austin, Nev., Front Range of Colo., and Duvall County, Tex.

Bagdad Copper Tries Ion Exchange in Test

PLANS for the early reopening of its pilot electrolytic plant have been announced by Bagdad Copper Corp., Bagdad, Ariz., according to PAYDIRT.

This plant was built in 1956 as an experimental and research center for the production of finished copper sheets from copper concentrates and from leaching low-grade copper deposits. It was operated until mid-1957 with satisfactory results. At that time production was discontinued in order that the plant's facilities could be utilized for further research.

During this two-year period of research Bagdad's chemists and metallurgists have devised a potential process through the adaptation of an ion exchange unit coupled with a resinous flow. In effect, the copper bearing solution from the leached ore is piped through a circuit where it contacts the resin, which replaces the detinned cans formerly used.

According to George Colville, executive vice-president and general manager, plans call for operation of the pilot plant on an around-the-clock basis for several months to further test the feasibility of the process.

At a recent meeting of the board of directors, David C. Lincoln of Cleveland, Ohio, was elected president of Bagdad Copper Corp. He succeeds his father, the late John Cromwell Lincoln, who died in Phoenix May 25 at the age of 93.

Australia *(Continued)*

company, has undertaken minimum development spending of £A45-million ($101.25-million) on the Weipa field, regarded as the most extensive in the world. Director of CAC, D. C. Hibberd, said last year that the ultimate investment in the field was expected to reach £A200-million ($450-million) and would provide a yearly return of about £A60-million ($135-million).

Much of CAC's spending had been on further prospecting to assess the extent of the Weipa field, on drilling for water and on construction of a small township, Mr. Evans said. The corporation was currently engaged in making a detailed survey at Port Musgrave on the northeast cost of Cape York Peninsula in an attempt to maintain a navigable channel and to establish a suitable harbor.

CAC was spending much more than it was required to under this agreement with the Queensland state government, Mr. Evans added.

An 800-tph capacity hoisting shaft is being planned for Mt. Isa Mines Ltd. in Queensland. With completion set at least five years off, the shaft will go to 3,200 ft, and be 24 ft. I.D. Many innovations are promised in the sinking technique and concrete placement methods.

IN THE PHILIPPINES

An attempt will be made to re-open the old Batong-Buhay mine in northern Luzon, which has been completely shut down since World War II. The mine had been operated for less than two years before the Japanese invasion and during its brief period of work some extremely high grade ore had been milled. Recently the company has been reorganized, more capital raised, and plans made for rehabilitation.

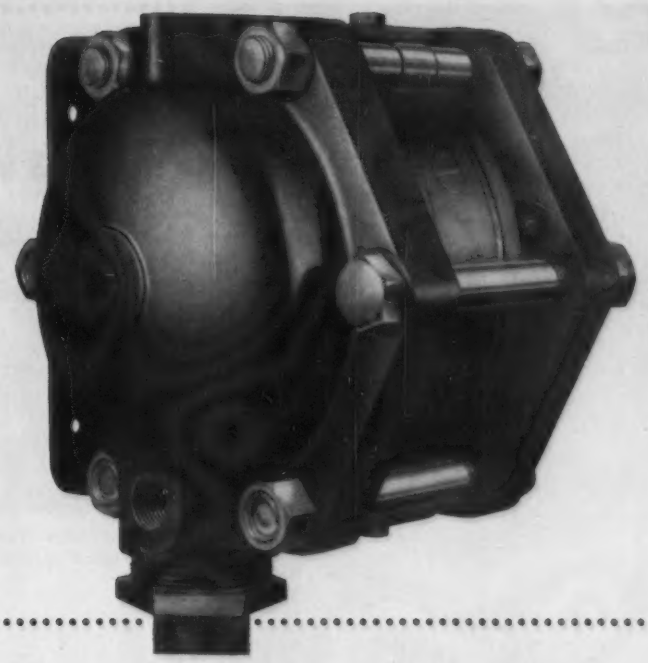
It is proposed to drive a new drainage tunnel to cross-cut the rich Dickson vein as well as five other promising surface outcrops of gold ore. The road to the mine has been repaired and is open for motor traffic. The power plant and mill are in good shape to resume work, and the old haulage levels in the mine have been re-timbered. Diamond drilling equipment has been ordered. Thomas I. Weeks is president of the company.

Itogon-Suyoc Mines has announced production for May. Gold production was the highest for any month this year, with recovery of 2,391 oz., in spite of a serious water shortage at the Itogon mill. Development work on the 1100 level is being pushed. C. E. Fertig is general mine superintendent. At the company's Suyoc mill in Mankayan in northern Luzon, milling began after a long period of mine rehabilitation and it is expected that the rated capacity of 300 tpd will be reached before winter. Present milling rate is 150 tpd. Suyoc was a rich prewar gold producer. Marsman & Co. manage both Suyoc and Itogon.

Atlas Consolidated reported lower tonnage milled in June at its Toledo copper mine. Mill heads also declined slightly. Total tons milled were 303,000 for the month, with production of 3,165,000 lb. of copper from 5,965 tons of concentrates averaging 26.5% copper.

Lepanto Consolidated milled 39,000 tons in June, producing in concentrates estimated to contain 2,729,000 lb. copper and 3,814 oz. gold. Mill heads held up well at 3.68% copper and 0.13 oz. gold. The mill operated continuously during the month.

Manila Mining Co. has been concentrating its development work on its high grade copper and gold claims in Agusan province, Mindanao. Chalres A. Mitke is president.



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- **Reference Data:** Write for Catalog C22-1 "Bellows Flow Meter".

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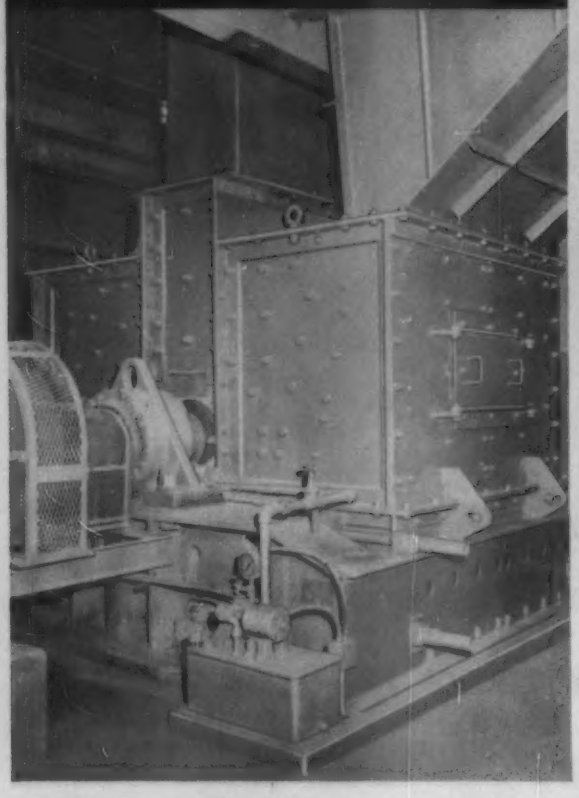

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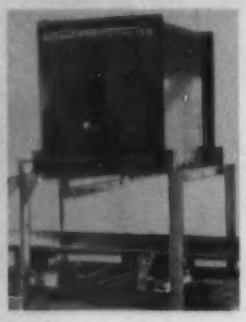

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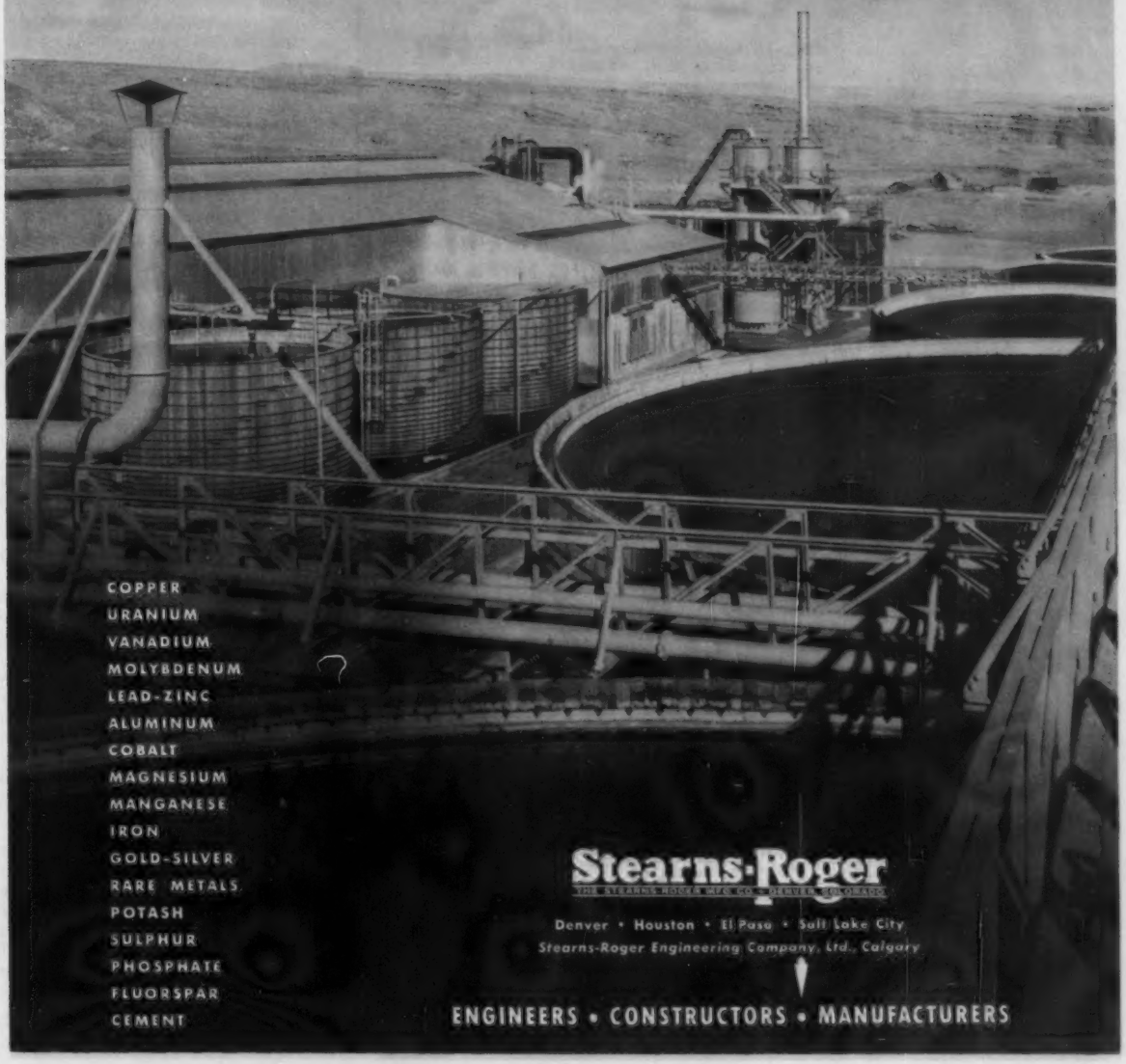

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Philippines *(Continued)*

Mindanao Motherlode Mines has suspended work in its copper mine in Zambales because of financial difficulties. Due to falling copper prices, the mine showed an operating loss the last two years. According to John C. Curtis, general superintendent, development work on the 500 level shows no indication of the orebody bottoming, but operations cannot be resumed on a profitable basis at a price less than 37-40¢ a lb. for copper, or some form of barter privilege so that peso returns on concentrates would be about three pesos per dollar. Ore reserves before shutdown were reported at 242,000 tons of 2.86% copper.

On June 20 Marinduque Iron Mines started its new copper-zinc mill at Bagacay, Samar, with a milling capacity of 600 tpd.

The new 40% Margin Fee bill for foreign exchange, recently passed by the Philippine congress, calls for payment of 2.8 pesos per dollar instead of the former statutory rate of 2 pesos per dollar, and exempts only cyanide, metallurgical reagents, grinding balls, and dynamite among mining supplies that must be imported. However, this has worked out to the benefit of the gold producers, who now find bids of 147 pesos per oz. on the open market for their bullion.

IN AFRICA

Ferroalloys' manganese ore reduction plant at Cato Ridge, near Durban, Natal, was expected to reach full production in early September, ahead of schedule. The first of the two large electric furnaces has been switched on. The furnaces will produce between 100 and 120 tpd of high carbon ferromanganese, using about 300 tons of ore. Ferralloys is an offshoot of the Anglovaal Co. and Associated Manganese.

Production from South African gold mines continued to rise steeply in July, reaching yet another record of 1,749,382 oz. This compares with 1,699,968 oz in June and 1,499,237 oz in July 1958.

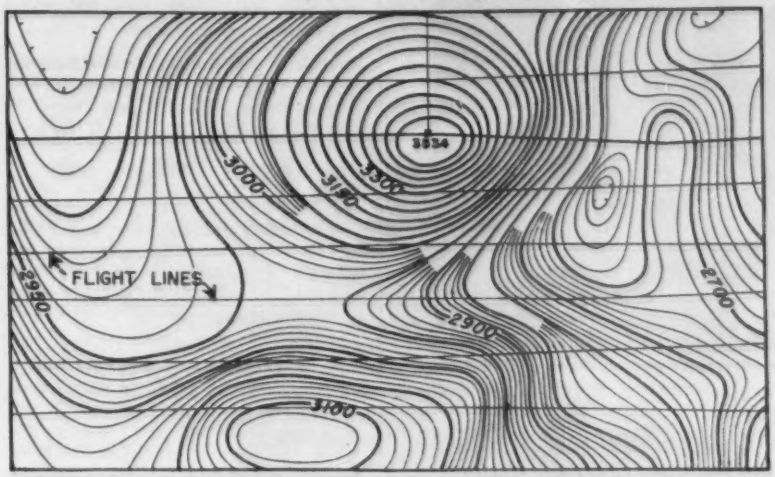
Value of the July output was £21,808,962 ($61,065,000) which is also a record for the industry thus far. Over the past 12 months gold production in the Union has risen by 16½% to reach an annual rate of £262-million ($733.6-million). The annual rate of production has risen by nearly £100-million ($280-million) over the past five years.

Two mine shafts are now being sunk on the Waterpan farm about 30 miles west of Johannesburg where Johannesburg Consolidated Investment Co., one of the Rand's important mining groups, and its associates in the Western Areas project have decided to go ahead with a new mine.

Southern Rhodesia has produced 16.7% of the total world output of chrome ore

Rich Mineral Finds Sought in Surinam

66,000-mile aerial survey being flown as part of Nation's 10-year development program



MAGNETIC SIGNATURES such as this Marmora anomaly are sought in the Surinam survey. Survey targets are iron ore, uranium, copper, other minerals.

FIRST STUDIES of this South American nation's geology indicate possibilities of mineralization similar to the rich Canadian Shield. An extensive aerial survey is now under way. It's the beginning of a 10-year intensive development program in Surinam.

The survey is being performed by Aero Service Corporation, Philadelphia, and its affiliate, Canadian Aero Service Ltd., Ottawa. Their joint resources are being pooled to complete the study at a quicker pace.

Photo-geologic Studies

First step was a geologic evaluation of 80% of the nation. Thorough study of existing aerial photos by skilled Aero geologists is guiding the extensive airborne geophysical survey. When all results are in and digested, the combined geological and geophysical data will lead to drilling of promising areas. Aero Service plans to complete the broad survey program in a year, flying conditions permitting.

Iron, Uranium Sought

It's hoped the survey will help uncover iron, uranium, copper, and other major minerals in this South American counterpart of Canada's mineral treasure house. Surinam wants to complete the survey quickly to share in the expanding minerals market.

According to a government spokesman, Surinam is actively negotiating further financial aid for this program. The government is encouraging long-term natural resources development through private enterprise . . . as part of Surinam's 10-year development program.

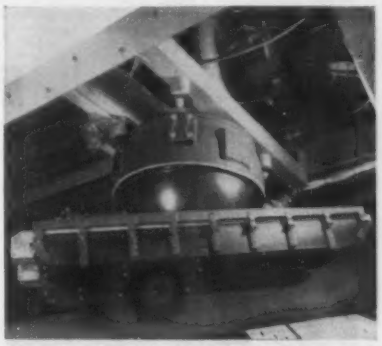
RADAN® Guides Survey

A specially modified Aero DC-3—equipped with modern exploration tools—is flying the survey over the dense, impenetrable jungle with the aid of RADAN® navigation system. A highly accurate plane-positioning system, RADAN operates without ground stations, photos or maps. More than 100,000 square miles of magnetic surveys over the Libyan desert and Spanish Sahara have been completed recently by Aero and Canadian Aero crews with the aid of this Doppler-radar navigation.

The exploration instruments are the Gulf magnetometer and Mt. Sopris scintillation counter. They are searching for new mineral deposits from a height of 500 ft. above the dense jungle cover in Surinam.

Other Surveys

Other Aero Service crews are presently at work on surveys in England, Turkey, Morocco, Thailand, Korea, Australia, Venezuela, Canada and the United States. Aero will be glad to provide complete information on the experience and capabilities of the company. Crews are ready to undertake new assignments anywhere in the world . . . and "on location" teams can cut mobilization costs for your survey project.



RADAN ANTENNA used in flights over featureless terrain helps plane maintain accurate positioning.

SPECIALLY MODIFIED DC-3—veteran of 100,000 miles of RADAN® Doppler-guided exploration over the Sahara—is performing Surinam survey.

Integrated Services

Aero's completely integrated mapping services include airborne geophysical surveys, geophysical interpretation, aerial photography, photo interpretation, photo mosaics, relief models, and topographic maps for railroads, mine developments, and mining communities. Aero is the oldest flying corporation in the world.

Aero Service Corporation world headquarters are located at 210 East Courtland St., Philadelphia 20, Pa. Aero's affiliate in Canada is located at 348 Queen St., Ottawa.

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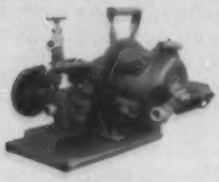
PACKSACK WORKS SAFELY UNDERGROUND ON COMPRESSED AIR!

Now, safety powered by compressed air, the Acker Packsack answers every need for a lightweight core drill for the mining industry.

The Packsack sets up quickly and is easy to operate — even where space is at a minimum. Use it for test holes, blast holes, plotting veins, wall sampling and exploration drilling.

For surface mining, the Packsack is available with a thrifty 5.5 H. P. gasoline powered drill.

Write today for Bulletin 22-EMJ



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Lightweight air motor driven pressure pump weighs only 70 lbs. Capacity 10 g.p.m. Makes a compact portable pumping station.

LOWEST DIAMOND COST

Acker Diamond Bits are scientifically designed and set for economical, long lasting operation.

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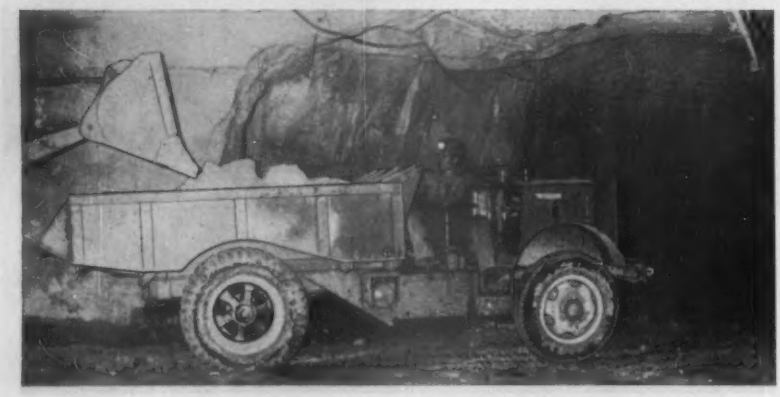
Over 40 years of experience manufacturing a complete line of diamond and shot core drills, accessories and equipment.

Wherever Ore Moves, SCOOT-CRETE

Ore Carriers Move It • FASTER • EASIER • AT LOWER COST



SCOOT-CRETE CD-4, shown being loaded in mine, will carry up to 15 tons payload. Model CD-3N has 5-ton payload. Note driver's side-mounted position for maximum vision and efficiency, forward and rear.

On the Western Slope, on the Colorado Plateau, SCOOT-CRETE does the job. No rails needed, no ties, no cars, no independent power source. Diesel-powered for operation inside the mine, SCOOT-CRETE carriers are rugged for around-the-clock service, carry up to 15 tons at speeds to 15 mph, climb grades up to 18%. All CD models approved by U.S. Bureau of Mines for underground mining.

Units available from 3,000 lb. to 15 ton capacity. Write for specifications and literature. See your Dealer.

GETMAN BROTHERS SOUTH HAVEN 2, MICHIGAN

Africa *(Continued)*

between 1827 and 1956—yet chrome production in the territory commenced only in 1907. This compares with 16.3% for Turkey where the industry is much older and 14.6% for the Union of South Africa. Southern Rhodesia's reserves of chrome ore now total more than 500-million short tons to shallow dep:h.

Statistics for base mineral export from the Union and South-West Africa show a substantial drop for the first quarter of this year compared with the 1958 figure. Asbestos was down by 1,000 tons; chrome ore by nearly 25,000 tons; copper by 2,700 tons; manganese by over 50,000 tons and zinc ore and concentrates by nearly 22,000 tons (or more than 75%). Antimony concentrates improved by about 75% (from 2,157 to 3,737 tons) and lead ore and concentrates by a less spectacular margin—from 50,580 tons to 58,272 tons.

General Exploration Orange Free State—an exploration company in the General Mining group—has accepted a 25% participation offer, both as to benefits and costs, with General Mining in the investigation of two Orange Free State areas totalling approximately 70,000 morgen (about 148,000 acres).

The areas are situated in the west and south of the present Orange Free State goldfields.

Life of the Motapa gold-mine, at Bubi, 65 miles north of Bulawayo, Southern Rhodesia, is now limited to the period necessary to work out the remaining available ore reserves. The decision to limit development to exploitation of the known orebodies was made after disappointing development disclosures.

In order to obtain maximum benefit from operations during the mine's closing stages, the monthly tonnage sent to mill has been reduced and the calcined residue dump is being re-treated. The remaining ore reserve and the dump will be exhausted simultaneously. Production at Motapa started in September, 1948.

IN EUROPE

FINLAND

The Pyhäsalmi base metals ore field, northern Finland, discovered a year ago during the digging of a well, is reckoned the most important of the many recent ore finds in Finland. It is now to be opened up with the aid of a 50 million West German mark credit at 6¼% granted to the Mortgage Bank of Finland and repayable in 15 years.

The State-owned corporation Outokumpu Inc. will exploit the deposits. Initial output will be 600,000 tpy. Proved reserves are sufficient for 30 years. The mine is expected to produce 5,000 tons of copper and 18,000 tons of zinc a year. Together with the Vihanti mine under the same ownership, it will bring Outokumpu's zinc production to 80,000 tpy,

YOU CAN'T BARGAIN WITH SAFETY

Wire Ropes may look alike... but it's performance that counts

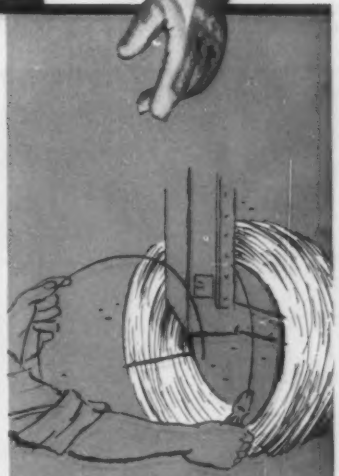
The Image of CF&I stands for the top performance records of all CF&I steel products. For instance, take one of these products—CF&I-Wickwire Rope.

Many brands of rope *look* alike but the rope you buy must pay off in *performance*, not *appearance*. With Wickwire Rope you get a number of quality factors that lead to outstanding performance. These factors are "built-in" the rope through many quality controls and tests. Since CF&I performs all steel producing, wire making and rope fabricating operations within its own plants, exacting control and testing procedures can be carried out and supervised at every step. Here is just one of these procedures:

Both-Ends Physical Tests

Samples are cut from both ends of every coil of wire and given complete physical tests — for tensile strength, roundness, torsion and uniformity of diameter. Coils that fail any test are rejected for such critical applications as wire rope.

We have recently printed several folders that discuss many more Wickwire control and testing procedures, plus wire rope recommendations for specific equipment. To get a copy, contact the nearest CF&I sales office—but please *state your industry or type of equipment.*



Both-ends testing of wire ensures safety and top performance in CF&I-Wickwire Rope.

WICKWIRE ROPE

THE COLORADO FUEL AND IRON CORPORATION 6958

In the West: THE COLORADO FUEL AND IRON CORPORATION—Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso
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CF&I STEEL

A STANDARD dryer plays an important role in R. J. Reynolds Tobacco Company's new research facilities.

A STANDARD rotary dryer is part of a $2,000,000 expansion in R. J. Reynolds Tobacco Company's research facilities in Winston-Salem, North Carolina. Many different blends of tobacco are processed in the 2 ft. x 12 ft. pilot plant STANDARD rotary dryer. STANDARD's reputation is built on ability to analyze, engineer and produce the most practical and efficient answer to any drying problem, no matter how exacting. Write today for our new informative dryer bulletin.

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ROTARY DRYERS • KILNS • COOLERS • ASPHALT PLANTS • CRYOGENICS

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Manchester Sand, Gravel and Cement Co.
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"We haven't spent a nickel or a minute on maintenance of our lifetime lubricated rollers and they've been on one D9 more than 1,300 hours. No sign of seal leakage, either!"

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.
Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Finland *(Continued)*

12 times the domestic consumption. Annual output of pyrite concentrates from the Pyhäsalmi mine will be processed as iron ore with an iron content equivalent to about 160,000 tons.

There are no restrictions in the loan agreement on country of purchase for the equipment to be ordered for the mine. It is probable that the majority of the orders will be placed inside Finland. The beneficial effect on the labor market adds to the significance of the loan which is made by the Kreditanstalt für Wiederaufbau, Frankfurt-on-Main. The fact that the loan is not covered by a Finnish State guarantee is taken as an indication of the value of the mining project. Another interesting feature of the loan is that it is the first loan taken by the Mortgage Bank of Finland from the European capital market. It is also the largest foreign loan granted for a single project in Finland.

(The new mining project is not to be confused with the Kolari iron ore field further north. This is to be exploited by another state-owned corporation, Otanmäki Inc., possibly with the aid of a ruble credit if and when Russia makes the much-talked of 500 to 600-million ruble credit available to Finland.—Ed)

HUNGARY

Hungary plans to import 4.2 million metric tons of iron ore from Russia this year, as compared to 3.2 million metric tons last year, Radio Budapest has revealed.

The Hungarian metallurgical industry is to increase its gross output 40% by 1965, as compared to 1958. This is much less than the average East-European (Soviet satellite) output increase which has been set at between 60 and 70% during the same period.

SPAIN

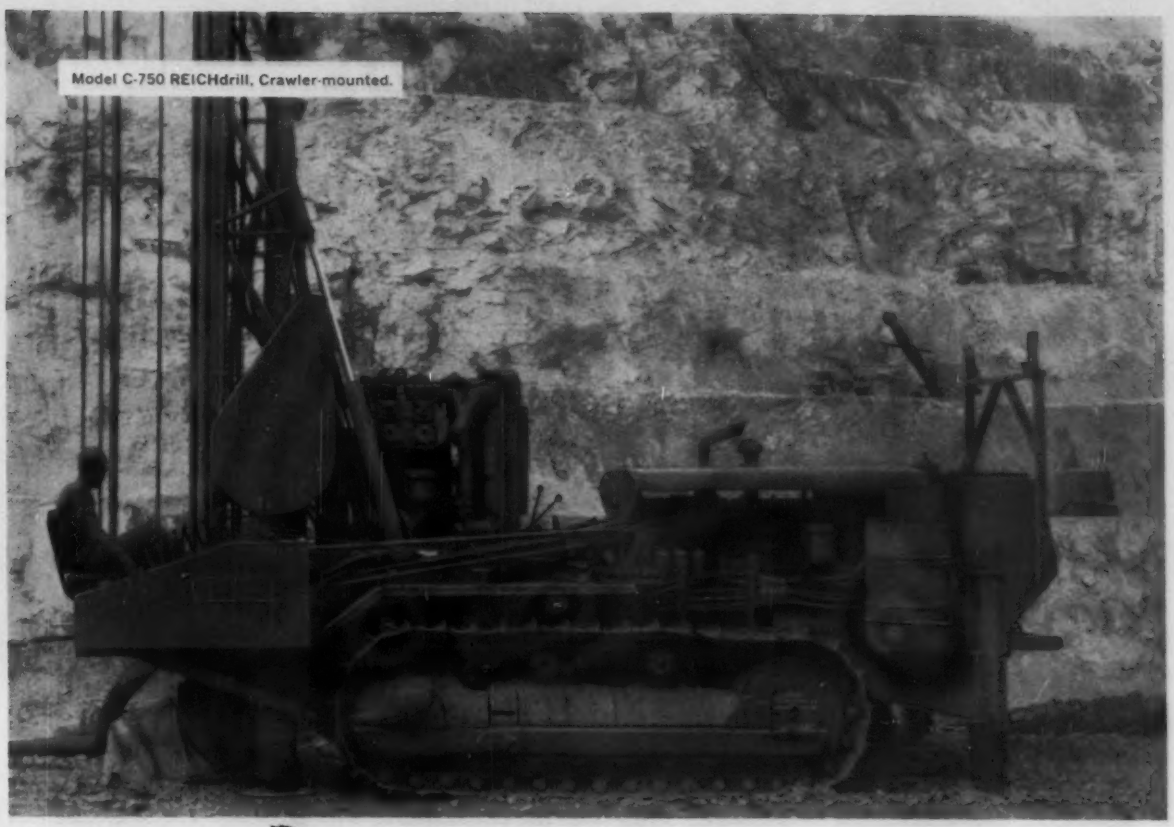
An official press release by Spain's nuclear energy commission stated that the processing plant of Andujar for uranium bearing ore is slated to go into operation next November. This is the second time the official inauguration of the plant has been set back.

An official spokesman of Spain's nuclear commission stated that important deposits of uranium ore were discovered in the southern area of Extremadura by a government exploration team.

According to the Spanish official, the Junta de Energia Nuclear backs the statement, and adds that the location of the newly discovered mines is off Trujillo, in the province of Badajoz of Extremadura.

YUGOSLAVIA

Yugoslavia's fully-nationalized nonferrous metals industry, based on the pre-war foreign enterprises which pioneered the



Model C-750 REICHdrill, Crawler-mounted.

IN METAL MINING
REICHdrills give you MUCH more hole per day

Model T-750 set-up for angle drilling, an exclusive REICHdrill feature. Units can be economically mounted on used highway trucks if desired.

And here are 4 rugged reasons why:

1. Variable rotation speed gives you exactly the right RPM for any material, rock to rubble.

2. Minimum of control levers for all operations means fast, easy handling by one man.

3. All controls actuated by smooth hydraulic power, saving operator time and tiring.

4. Extra heavy-duty construction on all component parts, including pumps, gears and frame means rig can take long, high speed duty without costly maintenance. Plus other field-proven features like hydraulic stem loader and down-the-hole hammer.

Units can be supplied truck or crawler mounted to suit operating conditions. Hole up to 12″ diam. Down pressure to 75,000 lbs. Write for detailed information on REICHdrills.

REICHdrill *Division: Chicago Pneumatic Tool Company*

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NO MAJOR REPAIRS IN 25 YEARS*

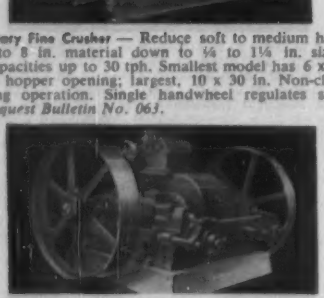
Sturtevant Construction Assures Long Mill Life at Top Loads

Sturtevant crushing and grinding machinery answers the long life top-load production problem for medium to small size plants. Many Sturtevants have been operating above rated capacities for more than 25 years, and *without a major repair.*

"Open-Door" design gives instant accessibility where needed — makes cleanouts, inspection and maintenance fast and easy. Machines may be set up in units to operate at equal quality and capacity.

Jaw Crushers — Produce coarse (5 in. largest model) to fine (⅛ in. smallest model). Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smallest sizes operate on double cam principle — crush double per energy unit. *Request Bulletin No. 062.*

Rotary Fine Crusher — Reduce soft to medium hard 3 to 8 in. material down to ¼ to 1¼ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Non-clogging operation. Single handwheel regulates size. *Request Bulletin No. 063.*



Crushing Rolls — Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 36 x 20 in.; rates to 87 tph. Three types — Balanced Rolls; Plain Balanced Rolls; Laboratory Rolls — all may be adjusted in operation. *Request Bulletin No. 065.*

Hammer Mills — Reduce to 20 mesh. Swing-Sledge Mills crush or shred medium hard material up to 70 tph. Hinged-Hammer Pulverizers crush or shred softer material at rates up to 30 tph. Four Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30½ in. Four Hinged-Hammer Pulverizers with feed openings from 12 x 12 in. to 12½ x 24 in. *Request Bulletin No. 084.*

**Reports Manager W. Carleton Merrill concerning Sturtevant Swing-Sledge Mill at James F. Morse Co., Boston.*

STURTEVANT
MILL COMPANY
101 Clayton St., Boston 22, Mass.

Yugoslavia *(Continued)*

field, has been able to achieve considerable output increases and has announced projects to boost production both for complete meeting of domestic requirements and increased exports.

Ore reserves are sufficient to permit high production over a long period. Estimates speak of a possible annual output level of 70,000 metric tons crude copper, 42,000 metric tons electrolytic copper, 20,000 metric tons crude zinc, 2,000 metric tons antimony, 600 metric tons of quicksilver—and as much as 300,000 metric tons of aluminum.

	1957	1958
Crude copper	33,735	33,000
Electrolytic copper	31,128	—
Refined lead	78,504	84,000
Crude zinc	16,481	31,200
Electrolytic zinc	12,560	—
Antimony	1,769	1,660
Quicksilver	425	?
Aluminum	18,134	21,700

SWEDEN

Uranium has been reported in the Bleckinger district. Preliminary investigations were conducted by Sydsvenska Kraftaktiebolaget of Malmo. The Swedish power company plans to obtain a concession from the King-in-Council in order to carry out a more thorough investigation of the deposit. Plans are also being made to hire geologists from Lund University for initial test work in the Ronneby area of the district. Testing is expected to begin in mid-1959.

POLAND

Thick layers of clay covering the 1957-discovered lignitic coal seams of Turoszov near Zgorzelec (Upper Silesia) have been tested for aluminum oxide content by Prof. G. Bretsznajder of the Warsaw Polytechnicum. DZIENNIK SUDOWY, a Warsaw daily, stated that preliminary studies showed the clay to contain enough aluminum oxides to make industrial production possible.

IN THE FAR EAST

MALAYA

The Malayan mining industry is feeling the effects of restriction on production and exports, it is reported. The following is a comparison of the number of various types of mines between November 1957, the last unrestricted month, and April 1959:

	Dredges	Gravel Pump Mines	Total Mines
Nov. 1957	78	589	732
April 1959	40	332	420

Malayan Tin Dredging Co., one of the major European concerns in the Federation of Malaya, put into operation for the first time a new M$8-million dredge on its mining property near Tanjong Tualang, 28 miles from Ipoh.

It is the third dredge belonging to the company working in the same area, the Kampong Gajah section, and was completed within the scheduled time.

One of the biggest in the country, and the first to be built in independent Malaya, the dredge was constructed by a Kuala Lumpur contractor, Kong Seong Soo, under the supervision of the company's engineering staff, headed by J. S. Clark, chief engineer.

The new dredge, 296 ft long, has a displacement of 4,400 tons, and is capable of digging to a depth of 130 ft. Its rated capacity is 400,000 cu yd a month.

JAPAN

Applications filed by the Mitsubishi group enterprises and Shin-Etsu Chemical seeking to obtain foreign technical information for domestic production of pure silicon is expected to be approved shortly by the Foreign Investment Council.

Mitsubishi Electric with Pechiney of France and Shin-Etsu with Siemens of West Germany expect to go into production early next year.

Need grinding balls in a hurry?

CONTACT UNITED STATES STEEL! If all of a sudden you find you're caught short on grinding balls, you can get them fast from United States Steel. For example, a West Virginia company needed 40,000 pounds of 2½-inch diameter USS Carbon-Manganese Grinding Balls in a hurry. They asked our Baltimore Office if the order could be shipped within two days after it was entered. We came to the aid of our customer and shipped his order *one day* after it was entered.

Though most companies place orders for grinding balls two to three months in advance, there are always emergencies . . . and United States Steel is ready to help you out when that emergency comes up. A complete stock of USS Carbon-Manganese Steel and USS Alloy Steel Grinding Balls is maintained at all times.

We can ship grinding balls almost any way you like: In 100-pound capacity burlap bags; in 2,000-pound capacity steel drums; in semi-trailer or dump trucks; in gondola or box cars (loose or in containers); or you can send your own truck if you like. The next time you need grinding balls contact the United States Steel Sales Office nearest you, or write or call United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Export Company

United States Steel

PERSONALS

Royale J. Stevens, Salt Lake City, has been named general superintendent of the reduction plant, Chino Mines Div., Kennecott Copper Corp.

Stevens

Stevens graduated from Columbia University in 1937 and was employed as smelter test engineer at Roan Antelope copper mine, Launshya, Northern Rhodesia. He was named assistant smelter superintendent in 1940 and smelter superintendent in 1946. He was assistant manager of Roan Antelope mine when he joined western mining divisions at Salt Lake City in 1956.

William M. Calhoun has been promoted to assistant to the resident manager of American Zinc, Lead & Smelting Co.'s Metaline Falls, Washington, operations. In addition to his supervisory duties, he will continue to direct all the local geological activities.

William Anderson, general superintendent of operations of the Star mine of the Bunker Hill Co. at Burke, Idaho for the past two years, has been named to the newly created position of general superintendent of Hecla Mining Co. operations. **William Dunphy,** Star mine foreman, has been promoted to Anderson's former post.

L. J. Randall, president of the Hecla and Lucky Friday Silver-Lead mining companies, Wallace, Idaho, has been named president of the Idaho Mining Association for 1959-60, and **A. J. Teske,** former editor of the WALLACE MINER, has been named association secretary, succeeding **Harry W. Marsh** who resigned. **Wallace G. Woolf,** vice president in charge of Bunker Hill Co. operations at Kellogg, is the retiring president of the association.

Charles E. Schwab, chairman of the national emergency lead-zinc committee, has been appointed manager of the Bunker Hill Co. operations in Kellogg, Idaho to succeed **Wallace G. Woolf** who will retire December 31. Schwab has been an assistant to **John D. Bradley,** Bunker president, for many years.

W. K. Field, New York City, assistant general purchasing agent for Kennecott Copper Corp., has been named acting purchasing agent for the Utah Copper Div. of the firm at Salt Lake City.

He succeeds **R. E. Cromar,** veteran employe in KCC's western mining divisions, who severed relations with Kennecott. Field will hold posts as both assistant general purchasing agent and acting purchasing agent at Utah Copper, until a successor to Cromar is named, a KCC spokesman said.

Thomas M. Ware, president of International Minerals & Chemical Corp., has been made chief executive officer of the corporation by the board of directors. He has been with IMC for 12 years, and was chief engineer, vice president of engineering, and administrative vice president before being named president in May of 1958. **Louis Ware** will continue as chairman of the board.

Dr. Andrew Jenike will presently undertake a survey of bulk material handling and storage methods of the steel industry in the iron range of Minnesota. The survey will be made on behalf of the bulk solids flow project, which is sponsored by the American Iron & Steel Institute and the Utah engineering expriment station of the University of Utah. The project will also benefit from a 3-year theoretical study of the flow of plastic solids which is now beginning at the University of Utah under the sponsorship of the National Science Foundation. The University has recently received a $57,000 grant for this study, which Dr. Jenike is directing.

C. A. Richards has been appointed administrative geologist for the city of Los Angeles.

Richards has been associated with Raymond G. Osborne Laboratories for several years and has also done consulting work in mining and petroleum in southern California, Arizona and Nevada.

Drury A. Pifer, director of the school of mineral engineering and professor of mining engineering at the University of Washington, has been elected to the board of directors of Sunshine Mining Co. He fills a board post recently authorized by increasing the membership from six to seven.

Robert H. Stebbins, formerly geologist with the raw materials exploration division, Columbia Iron Mining Co., U.S. Steel Corp., and previously consulting geologist to the same company, has

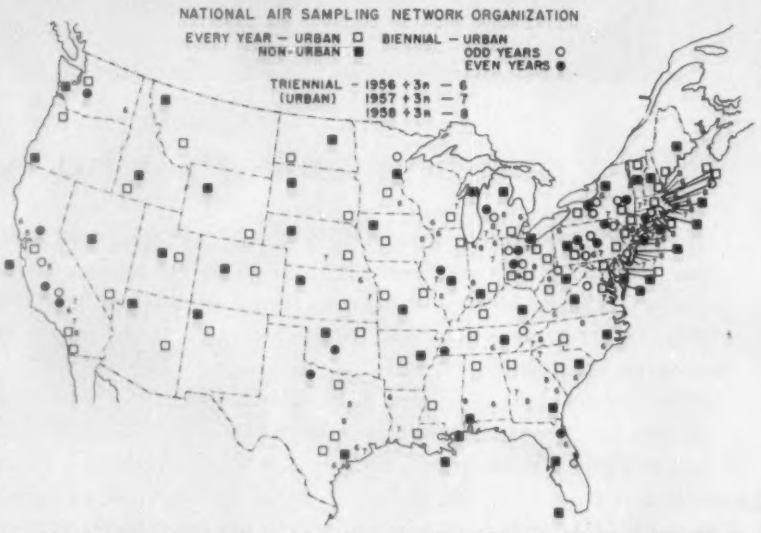
LETTERS

Air Pollution

E&MJ is to be congratulated for the fine job of objective reporting and public service represented by the lead article in the June issue, "Air Pollution—Industry's Challenge," and the accompanying editorial.

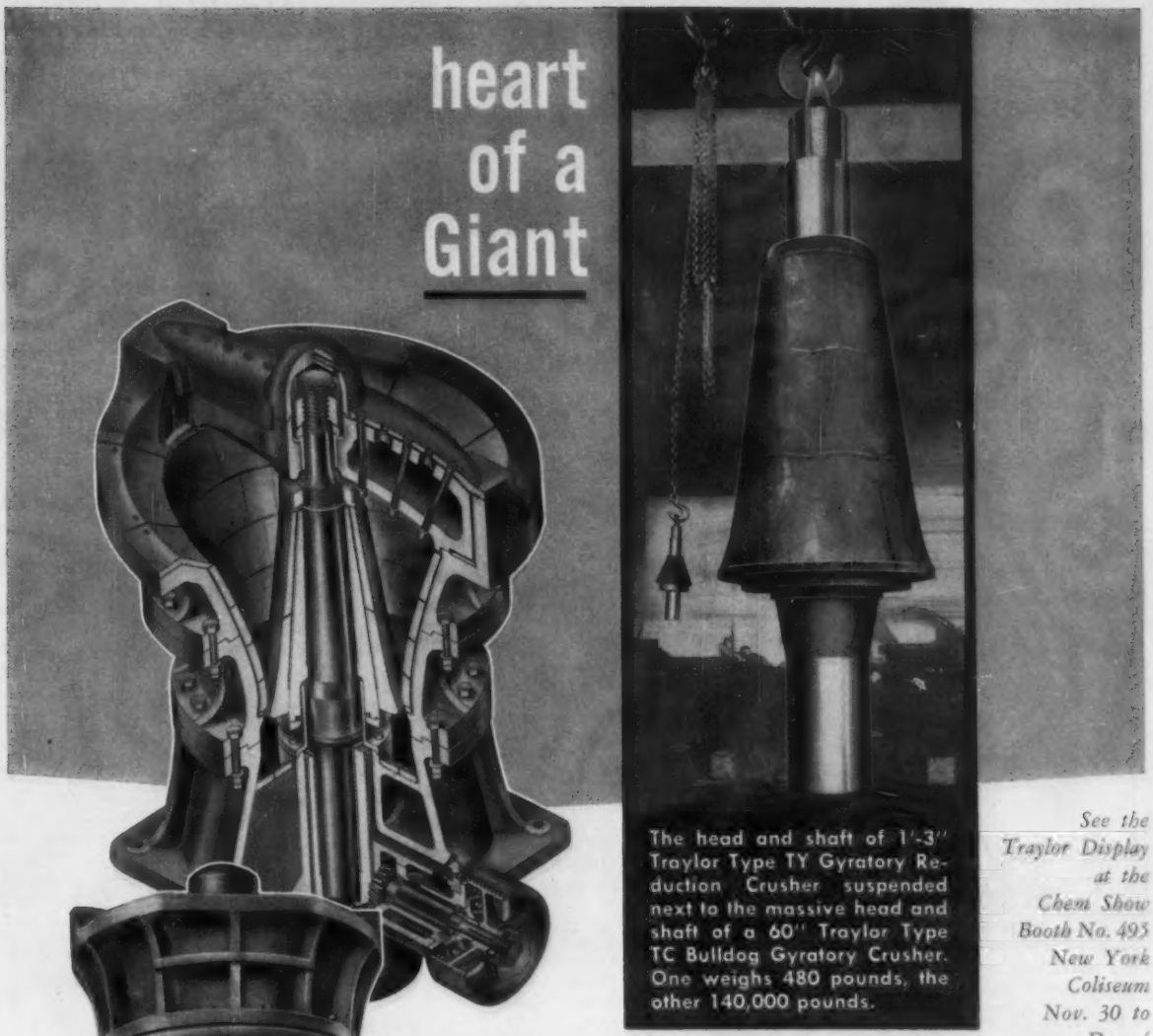
In view of the excellence of the presentation, it is rather picayune to point out a minor factual error that occurs in your reference to the National Air Sampling Network, particularly since this error most likely is due to the obscurity of my own writing. Your article states "most of the sampling stations in the National Air Sampling Network are in California (100 out of 158)." Actually, the figure of 100 out of 158 refers to automatic instruments for monitoring gaseous pollutants such as SO_2, oxidant, oxides of nitrogen, CO, etc. on a continuous basis, with the results being recorded on strip charts.

The National Air Sampling Network does not use automatic instrumentation. It uses glass fiber filters through which approximately 70,000 cfm of air are filtered over a period of 24 hours. These samples are returned to the Sanitary Engineering Center for analysis. As noted by you (from Dr. Burney's address at the bottom of p 69), at present, 180 cities and 51 nonurban areas have sampling sites, all manned by State and local personnel. There is a uniform distribution of sampling stations throughout the United States, with at least one urban and one nonurban station in every state, and in addition, urban stations in all of the larger cities of each state. This means that actually, most of the sampling stations are in the East. A map showing the location of sampling stations is attached for your consideration.



Sincerely yours,
Arthur C. Stern
Chief, Air Pollution Engineering Research

heart of a Giant



The head and shaft of 1'-3" Traylor Type TY Gyratory Reduction Crusher suspended next to the massive head and shaft of a 60" Traylor Type TC Bulldog Gyratory Crusher. One weighs 480 pounds, the other 140,000 pounds.

See the Traylor Display at the Chem Show Booth No. 495 New York Coliseum Nov. 30 to Dec. 4

Traylor **TC GYRATORY CRUSHERS**

Traylor Engineering is a specialist in designing and building primary gyratory crushers. The mammoth 60" crusher is capable of delivering 32,000 tons of product per eight-hour day. Traylor Gyratory Crushers feature original non-choking, self-tightening bell head and curved concaves. Write for Bulletin No. 1126 today.

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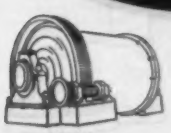

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PRIMARY GYRATORY CRUSHERS

JAW CRUSHERS

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Where DEPENDABILITY counts in centrifugal pumps

Flexible...

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WRITE FOR BULLETIN F-112

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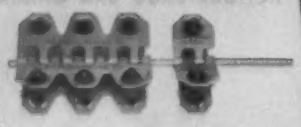
FOR EXTENSION BELTS IN MINING AND CONSTRUCTION



WRITE FOR BULLETINS 500X & 375

FAR-PUL® BELT CLAMPS

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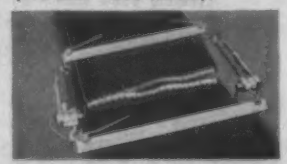

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Personals *(Continued)*

joined the staff of Hunting Technical Services, Inc., New York

Stebbins will be chief geologist and will be responsible for developing the activities of the new Hunting geophysical company in the U.S. and Mexico.

Fred A. Brinker is the new general manager, western division, Vanadium Corp. of America, according to a recent announcement by W. C. Keeley, Vanadium president. Formerly chief metallurgist, western division, Brinker has been associated with the corporation in an engineering capacity since August, 1951.

Mr. Brinker is a graduate of the Colorado School of Mines, and is a member of the American Institute of Mining Engineers and the Colorado Mining Association.

George W. Boulter has been appointed assistant manager of the mining division of Marion Power Shovel Co. He was formerly safety director of the Montana State Highway Department.

Mr. Boulter has more than 20 years experience in various operating capacities in the non-ferrous metal mining industry. He was formerly an application engineer for Joy Mfg Co., and Eimco Corp.

Richard N. Miller, assistant to the president of Vitro Uranium Co., has been named production manager for Heavy Minerals Co., Chatanooga.

Miller is a native of Pullman, Wash. and a graduate in mechanical engineering of Washington State University. He first joined Vitro Corp. of America in 1948 as a design engineer at New York.

William R. Mogg has been appointed general manager of Crucible Steel Co.'s Spring Div. He will be responsible for all phases of the Division's operations including production, sales, personnel, and administration.

Mr. Mogg succeeds **T. T. Crowley,** who has been named vice president and general manager of Crucible Steel of Canada, Ltd.

S. E. Jamieson has been elected president of British Metal Corp. (Canada) Ltd. He succeeds **K. A. Creery** who has been elected chairman of the board. He had been president since 1934.

John E. D. Grunow, secretary and attorney for Newmont Mining Co., New York, has been named to boards of Hecla Mining Co. and Lucky Friday Silver-Lead Mining Co. He succeeds **Carroll Searls.**

Two Stanford Research Institute mineral process engineers have been assigned overseas to give technical assistance to the Nigeria and India minerals industries.

Frank M. Hruz will spend a year in India making techno-economic surveys of the minerals and metals industries. His surveys are being supported by the India National Council of Applied Economics Research for use in the expansion of these industries.

Eldon P. Farley, a clay specialist, will evaluate Nigerian clay deposits and assist in establishing a clay industry. Hs work is part of a Nigerian technical assistance program.

Three geologists were made honorary members of the Billings, Mont. Geological Society on Aug. 12 at the opening of the groups 10th annual field conference in Great Falls, Mont.

More than 200 geologists from Montana and surrounding western states attending the meeting.

Presented with honorary memberships were **Charles E. Erdman,** research geologist for the Geological Survey in Great Falls, for outstanding work in the economic geology of coal, gas and oil in Montana; **Dr. W. T. Thom,** retired head of the Geological Engineering Department at Princeton University, for his studies of coal deposits in the Beartooth Mountain area, and **Dr. Eugene S. Perry,** former head of the Geology Department at Montana School of Mines in Butte, for work in geology of oil, gas and ground water.

Paul Buck of Great Falls and **C. M. Ogren** of Helena, high school instructors, were cited for advancing the study of science in general and geology in particular.

Milton A. Lagergren, graduate of the Colorado School of Mines and New York University, has been named project engineer for western mining divisions, Kennecott Copper Corp.

Until recently, Lagergren served as assistant to the chief engineer of Southern Peru Copper Co., Toquepala.

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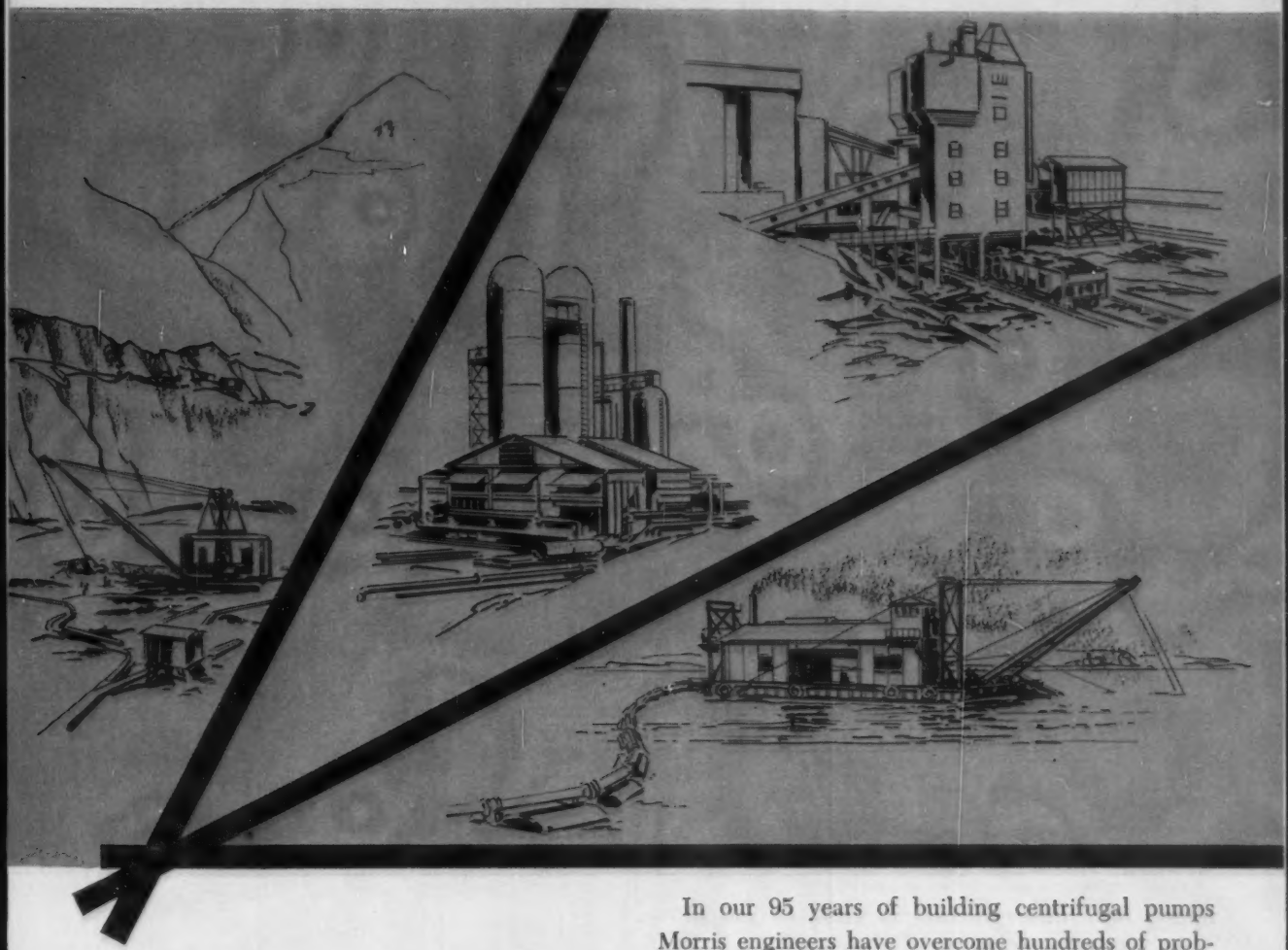

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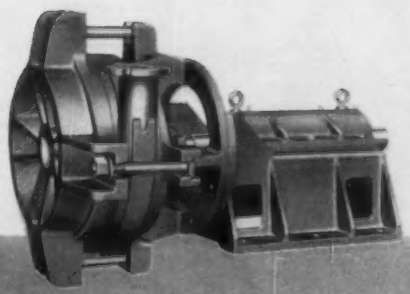

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Personals *(Continued)*

John W. Barnes, chief of the planning and evaluation branch of AEC's Grand Junction operations office, has been named deputy director of the office's source material procurement division. SMP administers contracts with uranium mills and producers.

Barnes, a veteran of 26 years service in the mining industry, first joined AEC in 1954 at Grand Junction.

David C. Lincoln, Cleveland, has been elected president of Bagdad Copper Co., Bagdad, Ariz.

Lincoln succeeds his father, the late John Lincoln who died at Phoenix May 25 at the age of 93.

George W. Colville has been named executive vice president. He has been serving and will continue to serve as general manager and treasurer.

James L. Oberg has become general manager of Metal & Thermit Corp's newly formed Metals & Minerals Div.

Oberg

According to Metal & Thermit president **H. E. Martin,** the new division will have responsibility for research, production, sales, and technical service for M&T metals and minerals, including ferro titanium, chromium, rutile, and ilmenite. It will operate mining facilities at Hanover, Virginia, and mineral milling operations at Carteret, N.J.

Mr. Oberg is also a vice president of International Titanium Corp., and supervises its operations and those of its wholly-owned subsidiary, Metal Recoveries Pty. Ltd. in Australia.

Ling-Altec Electronics, Inc. recently announced promotion for **Robert Martin, James Ross** and **Paul Goodwin,** three executives of the company's Ling Electronics division in Los Angeles.

Martin, who has been with Ling Electronics since its formation in 1953, has been made vice president and general manager. Ross, who also has been with Ling since its inception, is the new vice president in charge of research and development. Goodwin has been named chief engineer in charge of all Ling Electronics commercial and military product lines.

Glen Sherman Wyman, general manager of Andes Copper Mining Co., has been awarded the Medal of Bernardo O'Higgins by the Republic of Chile. The honor was given to Mr. Wyman in recognition of his "distinguished services in the development of the Chilean copper industry."

Phillip T. Maddex has been named chief engineer for the U.S. Borax & Chemical Corp. He will have the responsibility of directing corporate engineering activities and will be based at company headquarters in Los Angeles.

Maddex formerly served in various engineering capacities with General Electric Co., Owensboro, Ky.; Battelle Memorial Institute, Columbus, Ohio; and the National Lead Co., Sayerville, N.J. He was recently manager of the Henderson, Nev., plant of Titanium Metals Corp.

U.S. Borax also reports that **Arthur J. Weinig Jr.** has been appointed assistant chief engineer to supervise design and process development activities at the company's potash operations at Carlsbad.

Formerly general manager for the New Mexico Thorium Corp., Weinig also served with the Potash Co. of America for 18 years and was associated with the Farm Chemical Resources Developmen Corp.

David M. Checkley, former general manager of the industrial engineering division of Arthur G. McKee & Co., Cleveland, has been named president of Vitro Engineering Co., a division of Vitro Corp. of America, according to an announcement by Woodman Perine, vice president of the corporation.

Mr. Checkley graduated from the University of Illinois in 1940, worked for North American Aviation as an industrial engineer, and joined J. Gordon Turnbull, Inc. in 1944. He became vice president of the firm in 1951, in charge of planning and engineering work for 20 air force bases in England and Japan.

J. W. Burgess, Salt Lake City, will be the new chief engineer for the parent and all subsidiaries of the American

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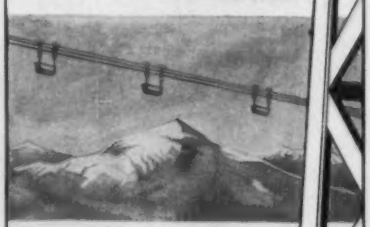

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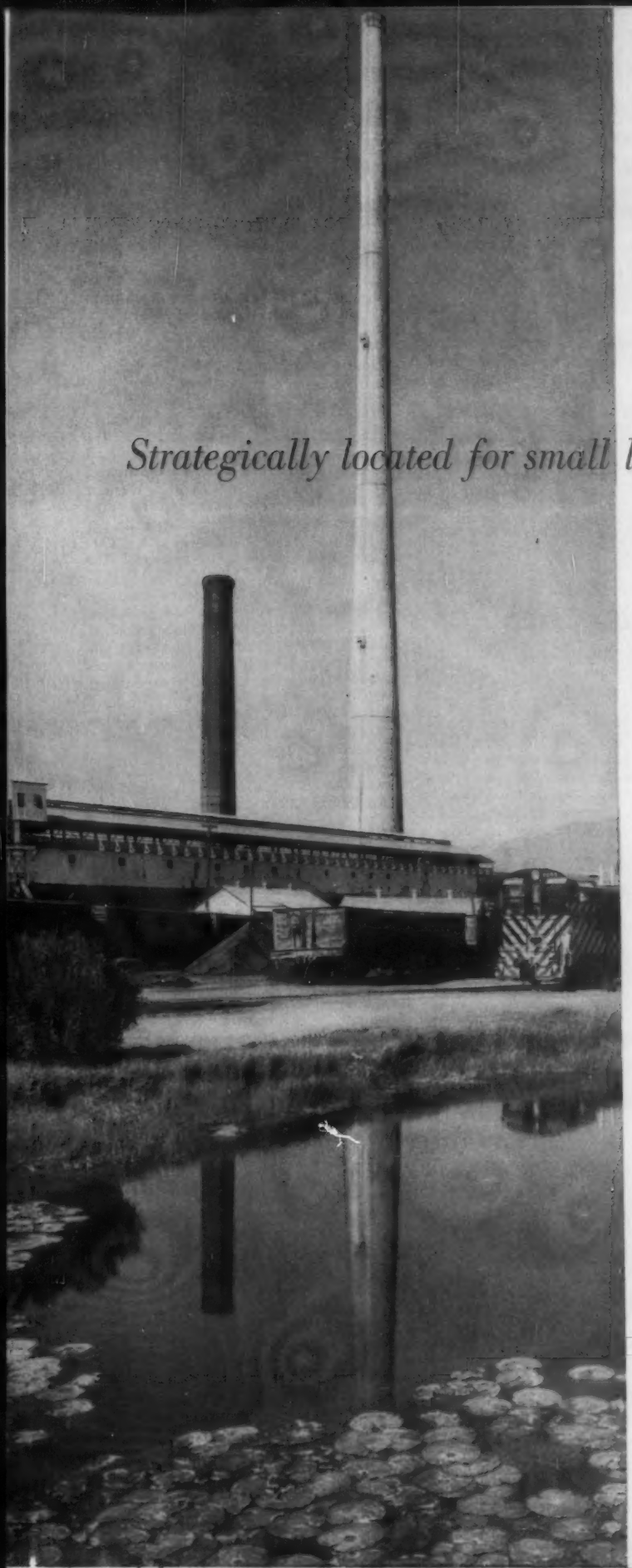

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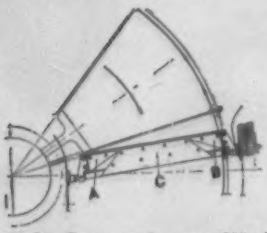

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Personals *(Continued)*

Zinc, Lead & Smelting Co. He had been manager of construction of the Uranium Reduction Co. since July, 1955.

Burgess joined American Zinc at Dumas, Texas, in 1941 as plant engineer, and was in charge of all engineering work at that operation until he was transferred to Salt Lake City as manager of construction for Uranium Reduction.

Charles H. Dunning, former director of the Arizona Department of Mineral Resources, and **Edward H. Peplow Jr.,** have published a booklet, "Let's Talk About Mining," which is a pre-publication of the first chapter of a larger work, "Rocks To Riches," the story of American mining.

The government of Argentina recently announced that **Julio Rudolfo Millan** has been appointed president of the directorate of Yacimientos Mineros de Aqua de Dionisio, a mining organization created in October 1958 to explore, develop, and commercialize the manganese, gold, and silver deposits at Farallon Negro, Catamarca Province.

OBITUARIES

E. F. Remer, 80, Hibbing, prominant in mining circles at the Mesabi range for many years, died July 28. In 1900, he graduated from the Michigan School of Mines and was engineer for the Isle Royal Copper Co. at Houghton, Mich. until 1903. He then came to the Mesabi range for the Corrigan-McKinney Mining Co. as engineer at the Stevenson mine. In 1912 he was promoted to superintendent of the company's St. Paul mine near Keewatin. In 1932, Mr. Remer organized the Charlson Mining Co., one of the first of the "independent" mining companies.

Tom Lyon, 71, former chief of the copper branch of the U.S. Defense Minerals Administration (1951-1954), died July 31 at San Diego.

After graduating from the Montana School of Mines in 1916, Mr. Lyon was employed by the geological department of the Anaconda Co. in Butte until 1920 when he was transferred to Salt Lake City. In Utah, he was chief geologist and later assistant general manager of the International Smelting & Refining Co. He was also an officer of several Utah mining companies.

At the time of his death, Mr. Lyon was consultant to the Southwestern Engineering Co. of Los Angeles.

John M. Bush, 83 died July 4 at the Michigan Union in Ann Arbor, where he had lived for the past two years since leaving Ishpeming. He retired in 1948 after having served for 25 years as manager of the lands and timber department of the Cleveland Cliffs Iron Co.

Ralph B. Utt, 51, vice president and executive chief engineer of the Western Machinery Co., San Francisco, died July 21 at Belvedere, Calif.

Utt

Mr. Utt had been associated with the Western Machinery and Western-Knapp Engineering Co. for nearly 20 years.

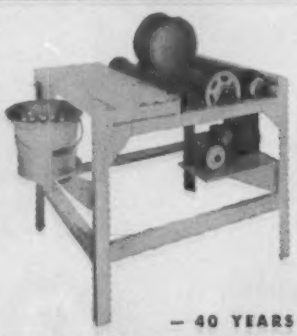
He attended the Montana School of Mines and graduated from the University of Idaho's School of Mines in 1934. Then, for some years, Utt was connected with the Glacier Silver-Lead Mining Co. and the Gem Mining Co.

In 1957, Mr. Utt was one of the American delegates to the International Mineral Dressing Congress, Stockholm, Sweden. He was a member of AIME, was vice chairman of the National Sand & Gravel Association, a member of American Mining Congress, mining section of the San Francisco Chamber of Commerce, and secretary of the minerals section of the Commonwealth Club.

Walter E. Scott Jr., 64, who retired earlier this year as Colorado commissioner of mines, died July 25 at Denver.

He held supervisory and management positions with several mining companies and was Gilpin County engineer before assuming his commissioner post.

Scott was a member of the Colorado Mining Association, the AIME, and the Professional Engineers of Colorado.



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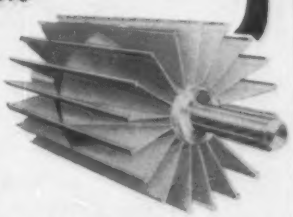

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0.6 Shift, Blaster	@	20.24	12.14
0.6 Shift, Blaster Helper	@	17.12	10.27
			$138.23
Explosives Required:			195.00
Machine Expense:			
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Estimated Cost: Drilling and Blasting			**$416.31**

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Doze off first layer and repeat process once
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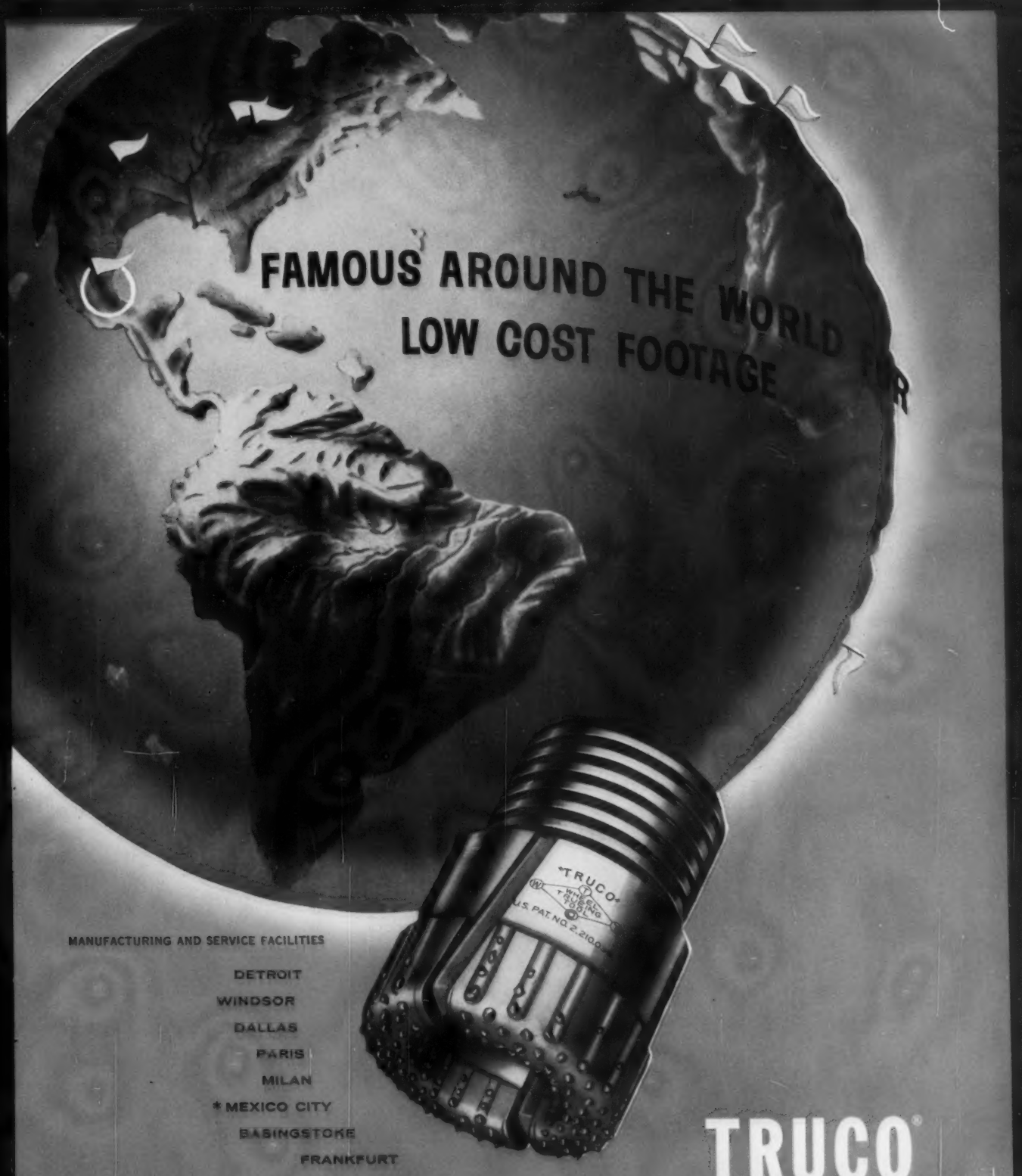

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